UGC Report on Student Learning and Quality of Life in the COVID Era and Beyond
May 2022

COVID-era impacts on student learning are a matter of global concern. To cite one economic measure, a study [1] conducted by the World Bank, UNESCO, and UNICEF (further discussion in a 3/14/21 LA times article [2]) estimates that students globally risk losing $17 trillion in lifetime earnings (14% of global GDP) due to COVID-related school closures and other disruptions. While such global findings may not provide a template for action that is directly applicable to the circumstances of UCB students, it is clear that the COVID era will have deep and long-lasting effects both on our students' learning experiences as well as on faculty instructional resources and teaching strategies. At the same time, along with the undeniable challenges and setbacks experienced by our students during this period, there are also indications that some of the innovations implemented in response to the pandemic show promise for improving instructional resiliency—and even instructional effectiveness for certain disciplines, student clienteles, and types of course—in the longer term. With this range of issues in mind, in December 2021, UGC, in coordination with Interim Vice-Provost for Undergraduate Education Oliver O'Reilly, set in motion a plan to formulate UGC's perspective and recommendations in these areas as of Spring 2022.

Part I. The Current State of Affairs and Ongoing Data-gathering Efforts

Systematic efforts to gather concrete data on COVID-era challenges to student learning (as well as areas of potentially productive innovations) at UCB are already underway. Our faculty colleague from the Graduate School of Education Zach Pardos, who graciously agreed to serve as an outside member of the UGC group convened to gather input for this report, has produced a detailed study of impacts on learning during emergency remote instruction during the Spring 2020 semester that identifies several areas for concern, as well as points where lessons learned during remote instruction show promise for improvements in instruction and student experience [see Appendix II].

There was an apparent slight decrease in preparation for Fall 2020, with a 6.4% increase over non-emergency semesters in No Pass grades for students who had satisfied course prerequisites during Spring 2020. Levels of late assignments submitted in the last week of Spring 2020, moreover, were orders of magnitude higher than in past semesters. Perhaps still more troublingly, there were indications of disparate impacts across different student communities, with a 10% average decrease in engagement (as measured via UCB Learning Management System [LMS] data) among African American and Native American students for the weeks following spring break.

At the same time, Professor Pardos's study points to areas of potential benefits from some of the processes put in place during emergency remote instruction. There were indications of increased grading speed, and in length of instructor feedback as delivered via LMS. There was no significant change in course drops in Spring 2020 as compared with baseline data, and no significant negative impact on letter grades appeared in coursework where students had completed course prerequisites in Spring 2020.

A major stipulation here is that the picture regarding COVID-era disruptions at the primary and secondary levels (as reflected for example in a 9/16/2021 *Frontiers in Psychology* study [3]) is in general both better-documented, and also more uniformly negative. This means that even under the most favorable conditions for our emergence from the pandemic in the coming months, incoming UCB undergraduate students (in both four-year and transfer programs) for the foreseeable future will be coming out of this COVID-impacted terrain. It stands to reason that we on this campus need to think and prepare ahead of time to meet the challenges that will predictably arise for these cohorts of incoming students.

In addition to this useful baseline study of impacts of emergency remote instruction in Spring 2020, preliminary results are now available from what are slated to be ongoing efforts to monitor COVID-related impacts on instruction. Among the recommendations of the Fall 2021 Taskforce on the First-year Undergraduate Academic Experience (hereafter "First-year Taskforce") was a mandate that surveys on COVID-related impacts be carried out each semester among groups of both instructors and students over a period of four years. It is our understanding that these surveys are being fine-tuned as this fact-finding initiative continues, and that their scope will soon be expanded to include advisors as well. We heartily endorse all these dimensions of this vital effort.

Results for the first (Fall 2021) rounds of the instructor and student surveys are now available. The instructor survey, circulated among instructors in courses in the Common Good Curriculum (CGC), yielded a generally mixed picture, with reports of learning loss in some areas along with reports of improved performance under emergency remote instruction in others (full survey results can be accessed here [4]). The first round of student survey, conducted under the auspices of the Student Learning Center, was designed to provide a snapshot of student experiences and concerns. While this survey was not weighted to account for factors such as response rates and breakdown by program, the overall level of response (850 responses and 1838 individual comments), particularly given the timing and the short (3-day) turnaround for this survey, indicates strong student concerns around COVID-related learning loss (the full survey report can be accessed here [5]). Strong majorities (in the mid- to upper seventies by percentage) of students responding somewhat or strongly agreed that COVID-related disruptions had caused some degree of learning loss; and that the accompanying social isolation, as well as general pandemic-related stresses, had presented obstacles to their learning experience.

It is clear that the impacts relating to COVID-era disruptions to instruction will be with us for a long time. We enumerate in the following section some general recommendations for measures that might be taken immediately to respond to these challenges. At the same time, we feel that it is of almost equal importance that these vital data-gathering initiatives be continued and refined into (at least) the near to medium term, so that we can continue as a campus to respond in an effective and targeted way. The pandemic has had a major impact on students' foundational skills, preparation for advanced courses, and ability to succeed in a rigorous academic environment. While "learning loss" of one kind or another will certainly manifest itself at the undergraduate level, it will likely have had a much larger impact in high school. Multiple years of completely online or hybrid high school classes has likely resulted in a less thorough instilling of fundamental skills in mathematics, reading comprehension, and analytical writing. The loss (or rather, underdevelopment) of these skills may have an even greater effect on student success at Berkeley than the loss of more advanced content undergraduate students may have learned through online college courses. We therefore also recommend that—given that, as noted above, the negative impacts of COVID-era disruptions at the primary and secondary levels are more pronounced that those known to date based on surveys of matriculated UCB undergraduates—such surveys be formulated where possible to assess impacts of COVID-related disruptions that occurred before matriculation: e.g., What was the effect of high school learning loss and in community college on new freshmen and transfers? What subjects and classes are facing the biggest challenge with academic preparation due to learning loss, and what supports might be effective?

Part II. Recommendations

(a) First-year Experience

As suggested above, many of our concerns relating to COVID-related impacts on learning overlap with the scope and findings of the Fall 2021 First-year Taskforce (the Taskforce's full recommendations may be accessed here [6]). Indeed, for a variety of reasons, despite all we do not yet know clearly enough about how the pandemic era will impact our students and accordingly our teaching approaches, we can be certain that many of the most pressing problems will predictably arise for students beginning their transition into UCB campus life, and into what we hope will be rewarding academic tracks, in their first year of residence. Accordingly, we endorse the First-year Taskforce recommendations, particularly as regards, e.g., centralizing messaging regarding transition resources such as Summer Bridge, and enhancing (and better advertising) resources such as Berkeley Connect to provide informal peer-to-peer advising, as well as the Taskforce recommendations regarding the creation of a streamlined curriculum management system. More generally (and again, in broad agreement with the recommendations enumerated in the report of the First-year Taskforce) we find it of crucial importance that we as a campus foster clearer messaging around advising resources, particularly in relation to course enrollment and the development of an academic plan. We are also encouraged to note the efforts underway to improve advising resources under Berkeley Online Advising.

(b) Equity/Access

While many of the impacts of COVID-era disruptions to instructional continuity for our campus are yet to be clearly delineated, it is already clear (both on our campus and beyond) that COVID-related impacts are being felt disparately across different demographics. We should not wait for further clarity or data about COVID impacts before taking action in relation to these challenges. While some students with stable housing, economic, and family situations have had experiences in remote instruction that usefully point the way toward positive potentials for future improvements in teaching and learning, students facing challenges in any or all of these areas have been—as has been thoroughly documented—impacted in vastly disproportionate ways. We feel strongly that we as a campus should take the initiative to mitigate these challenges to the utmost of our ability, both financially (i.e. as a matter of campus budgeting and priority-setting) as well as ethically (as members of an academic community that shares values of inclusion and access). Areas requiring sustained attention include psychological and counseling support for students (as well as staff and faculty) facing traumatic and challenging life situations beyond campus; issues of access related to technical support (e.g. access to laptops/notebooks, headphones and the like), as well as provisions for support staff (both hiring appropriately trained support and academic staff as needed as well as providing appropriate training for existing staff and faculty). It should be anticipated that responding at this level will likely include a need for expanding both the numbers of advising staff and the kinds of specialized training that will be required to address these needs, as well as active outreach to departments and faculty to raise awareness of these problems and to offer training and support.

(c) Program Disparities

A further area of concern where immediate action strikes us as warranted relates to program disparities relating to prerequisites, eligibility, selection criteria and admission processes across majors and across colleges. The complexity of multiple colleges and programs may create obstacles, but we support efforts to address inequities and disparities that arise with undergraduate programs whose requirement structures in effect limit access to students who commit immediately on arrival (or even earlier), including inequities arising from disparate access to AP credits prior to arrival on campus. The First-year Taskforce plans regarding the implementation of "meta-major pathways" for

L&S students strike us as one promising avenue for helping streamline this process for incoming students. More generally, fragmentation regarding requirements across colleges and programs on campus strikes us as an obstacle to our mission to help the largest possible proportion of incoming students to find and navigate an academic program successfully (and in normative time). We endorse providing students with more choice as to which courses satisfy key college or major requirements—STEM students, for example, might prefer a more technical course, whereas students in humanities might want to take a course more related to the social impacts of a certain field. We also suggest reflecting on whether introductory college or major requirements need to be taken for a letter grade in order to adequately prepare students for subsequent courses. For example, students with AP credit might pass out of certain college requirements, which students without AP classes in high school will have to take equivalent courses at Berkeley and already feel "behind" their peers.

(d) Grading Policies

It has been an insistent refrain in discussions around issues relating to COVID-era impacts, as well as around general issues of academic climate, that curve-based grading has an adverse effect both on learning outcomes and on students' morale, sense of community, and overall learning experience. We understand that artificially imposed course curves are part of the grading and more generally evaluation culture in many sought-after disciplines represented on our campus, and are therefore not naïve about the prospects of abrupt or unilateral changes in that regard. What we call for, therefore, is simply a minimal recognition that such practices are manifestly corrosive of student morale, or of any sense of academic endeavor as an arena of intellectual exploration and discovery, as opposed to a zero-sum contestation for relative benefit or advantage. It is exceedingly clear to us collectively, at any rate, where the real interest of the university's mission, as we conceive it, lies. Therefore we encourage even (and especially) faculty in fields where curve-based grading is a cultural norm to think creatively about alternative models, and to reflect dispassionately on the often corrosive impacts of such practices on student well-being and community.

We recommend not only that the artificially imposed curve-based grading model be abandoned wherever feasible, but that other expedients—including but not limited to expanding the spirit of the College of Engineering's "Grading for Equity" workshops [7] creating smaller sections specifically for underrepresented students, or students with no previous experience in the course's subject (as in, e.g., the CS Scholars and Data Scholars programs [8, 9]), and, more generally, acknowledging that students come into a course with varying backgrounds and levels of experience, and providing resources/support for students to (re)learn material as needed.

(e) Academic Expectations

Although the picture of adverse impacts and areas for breakthrough in the latter stages and eventual aftermath of a pandemic era is still far from clear, it is already clear that many UCB students will be experiencing residual negative aftereffects of the pandemic and its educational impacts well into the medium term (at a minimum, over the next five or six years). Faculty and academic advisors should therefore be prepared to alter their expectations related to assumed prerequisite knowledge for courses and the speed at which students may grasp more advanced content. We support messaging at the campus level to encourage faculty to consciously adjust their expectations of student academic performance. We look in particular toward further iterations of the ongoing surveying of both students and faculty (under the recommendations of the First-year Taskforce) to provide ongoing feedback and direction as to where the main problems lie in these regards. We as a campus should be prepared to respond to deficits particularly in students' foundational knowledge (e.g., calculus for Engineering students) with supplemental advising and "bridging" curriculum.

(f) The "Post-pandemic" World

At a more general level, our discussions touched on ways in which the pandemic has reshaped student perceptions of academic workload and school-life balance. Simply put, students are no longer willing to sacrifice as much of their lives to academic assignments and studying. Students—like workers across the nation—are reassessing how much they work in exchange for a certain reward, whether it be a salary or a degree. What was an acceptable workload prior to the pandemic is no longer acceptable to workers and students in a post-pandemic world that has highlighted the need for increased job flexibility and a proper work-life balance. Academia is not immune to the "great resignation." As a campus we may risk losing talented students to burnout and dropout if we do not adjust our expectations of what it takes to "succeed" at the undergraduate level. This risk is particularly acute for low-income and underrepresented students, who will likely be disproportionately affected by pandemic-related learning loss.

(g) Academic Culture and Climate

Reflecting on the challenges that COVID-19 era disruptions have presented our campus, we are consistently reminded that such "COVID challenges" are not in fact radically separable from broader long-term challenges we face in promoting quality of life and academic engagement for UCB students. Thus for example the move to emergency remote instruction allowed for a degree of instructional continuity during the COVID lockdown period, but also brought to the fore issues of equity for students with unequal access either to devices or to stable living environments in which to engage in their remote coursework. Conversely, while the pandemic-imposed period of emergency remote instruction caused widespread hardship, it at the same time uncovered a pent-up desire among many of our students for more flexible modes of instruction (as in e.g., scheduling and pace of instruction). Stress and impacts to student morale that manifested with particular force under pandemic-impacted conditions, moreover, are not separable from the cultural forces that bring students to view academic life as a winner-takes-all struggle for survival, where micromanagement of GPA takes precedence over—or simply precludes the development of—a love of learning and academic discovery for its own sake. Therefore, as we continue to assess and respond to impacts specific to the pandemic and its aftermath, we feel it is of vital importance that the Academic Senate continue active engagement with these processes of response and reassessment of academic and quality of life issues. We are aware that an advisory group under the auspices of the Research, Teaching, and Learning (RTL) Services is currently carrying out some of this sort of effort, and we endorse further and sustained Senate engagement with this initiative, including, if deemed appropriate, the formation of a Berkeley Division standing committee on these long-term issues of pandemic response and educational quality.

We also note that whereas this report is primarily directed toward DIVCO for further discussion and deliberation within the Academic Senate, many of the relevant issues are of a pressing nature, and that specifically it seems wise to seek updated community input and formulate campus response ahead of the Fall 2022 semester.

<u>Concluding comments</u>

COVID-era disruptions to our campus "normal" have presented arduous immediate challenges to our ability to carry out our academic mission. These immediate impacts, beyond doubt, require our urgent attention, and we have indicated some of the general areas where we feel effort is needed—along with the nearly-equal need to continue actively seeking clearer definition of both the challenges as well as possibilities for productive breakthrough, via continued formal data gathering

as well as via less formal avenues of input such as townhalls and targeted discussions at the campus, college, program, and departmental levels. In regard to both the negative impacts of the pandemic on our campus and our (present as well as incoming in the near to middle-term) students, as well as the opportunities for innovation in our modalities in teaching and learning and more generally interacting as a community, our main conclusion is, in short: despite all our pandemic fatigue, there will be no simple return to a "pre-pandemic" normal for us as a campus, and the more consciously and actively we can implement this awareness of the need to create a new "normal," the better our prospects, for the university's academic mission as well for our well-being as a community, will be.

Amanda Hill (ASUC/UGC)

James Weichert (ASUC/UGC)

Zachary Pardos (Graduate School of Education/COCI)

Laura E. Perez (Ethnic Studies/UGC)

Robert Ashmore (East Asian Languages and Cultures/UGC)

Approved 05/04/22 by UGC. Accepted 05/09/22 by DIVCO.

Appendices

I. External links

[1] UNESCO, UNICEF, World Bank joint report, "The State of the Global Education Crisis: A Path to Recovery" [12/3/2021].
[2] "The profound costs of global learning loss, and what can be done about it" [*LA Times*, 3/14/22].
[3] "Effects of COVID-19-Related School Closures on Academic Achievement–A Systematic Review" [*Frontiers of Psychology*, September 16, 2021].
[4] "Learning Loss During COVID: Survey of Common Good Curriculum Instructors" (Office of the Vice-Provost for Undergraduate Education, January 2022).
[5]"Survey Results Report: Student Perception of Learning Loss" (Berkeley Student Learning Center, 3/31/2021).
[6] Recommendations of the First-Year Experience Task Force
[7] College of Engineering guidance on equitable grading strategies.
[8] EECS, CS Scholars Program.
[9] Computing, Data, Science, and Society, Data Scholars program.

II. Zachary Pardos, "Resilience or Loss? Learning Under Emergency Remote Instruction at Cal"

Resilience or Loss? Learning Under Emergency Remote Instruction at Cal

A Learning Analytics Perspective

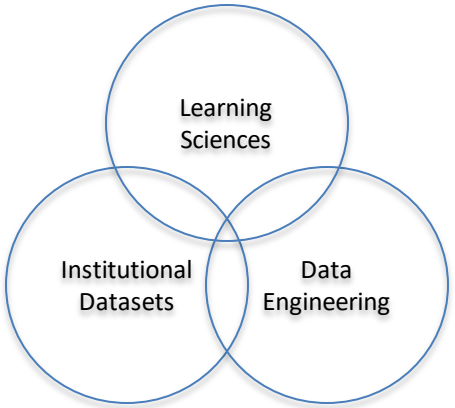
Zachary Pardos
Associate Professor
Graduate School of Education

Berkeley
UNIVERSITY OF CALIFORNIA

Motivation

The global COVID-19 pandemic led to an emergency move to remote instruction at the University of California, Berkeley in March of Spring 2020. Dozens of reports and papers have emerged studying the impacts of this move at institutions around the world using **surveys** of students and faculty (Bond et al., 2021).

This study presents the first analysis exploring the impacts of emergency remote instruction at an institution of higher education using a **learning analytics** approach.



Related Work

Means & Neisler (2020) Nation-wide survey of 1,000 undergraduate students

- Average course satisfaction dropped during remote, from 51% to 19% “Very satisfied”
- Better Online: Understanding course expectations, instructors’ knowledge of students’ strengths/weaknesses
- Worse Online: Keeping interest in course content, opportunities to collaborate with other students
- Serious internet connectivity issues among 44% of students

Related Work

Motz et al. (2020) survey of 6.2k students and 1.5k instructors at Indiana University

- Students felt online coursework took more effort and that the online experience affected their student identity

Wise, A. F. & Bergner, Y. (2020) survey of 298 students at NYU

- Opinion of online learning was worse among women than men and worse among undergrads than graduate students
- Self-reported quality of learning experience moderately increased throughout remote instruction (3.11 -> 3.30 -> 3.66)

This Learning Analytics Project

Proposal:

1. Observe any changes in instructor and student engagement with the learning management system (LMS; i.e., Canvas bCourses) before/after start of emergency remote instruction
2. Compare to past Spring semesters
3. Explore if course grades in Fall 2020 indicate if there was significant learning loss during Spring 2020

Funded by the Office of the Executive Vice Chancellor and Provost in Summer of 2020

Internal Review Board

"**Investigating the Impact of Emergency Remote Instruction on Learning at Cal**"

- Evaluated by Committee for Protection of Human Subjects
- Determined not to be human subjects research
- Determination required all data be anonymized to the PI
- Course content not included (e.g., no homework submissions, no assignment descriptions, no instructor comment text)

Protocol ID: 2020-06-13377

LMS Dataset (Canvas)

- Assignments: Instructional staff created assignments and assignment types (E.g., Quizzes, Wiki posts, paper submissions, tests, discussion posts assignments).
  - Published: 38,894; deleted: 9,486; unpublished: 2,429
- Assignment Overrides: Edits made to assignments after creation
  - 6,666 records
- Submissions: Student submission of assignments along with grade information
  - 814,633 records
- Submission Comments: comments submitted by instructors and responses by students
  - 369,492 records (188,476 by teachers)
- Discussion Topics / Announcements: Created by instructional staff
  - 84,355 records created by teachers
- Discussion Posts: Created by students
  - 146,682 records

LMS Dataset (Canvas)

2020 Spring:

- Students (40,034)
- Teachers (3,759)
- TAs (3,372)
- Observers (1,304)
- Designers (69)

- Classes (3,729)
- Class sections (7,382)

2017 Spring – 2020 Fall:

- Students (100,434)
- Teachers (10,552)
- TAs (13,510)
- Observers (9,997)
- Designers (412)

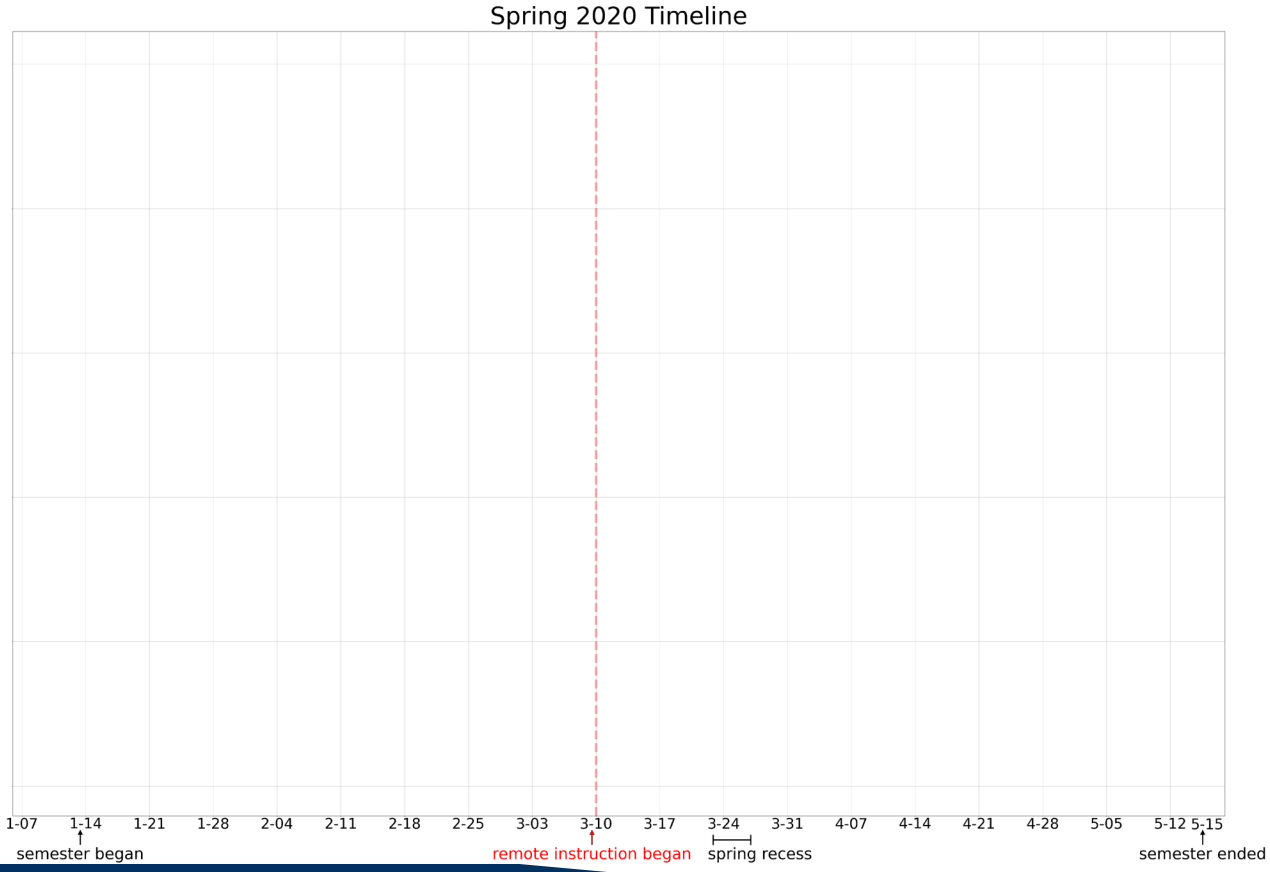
- Classes (28,984)
- Class sections (59,844)

Instructor engagement analytics

(using LMS dataset)

- Frequency of assignments
- Assignment extensions
- Course communications
- Time to grade assignments
- Feedback given on assignments

Timeline



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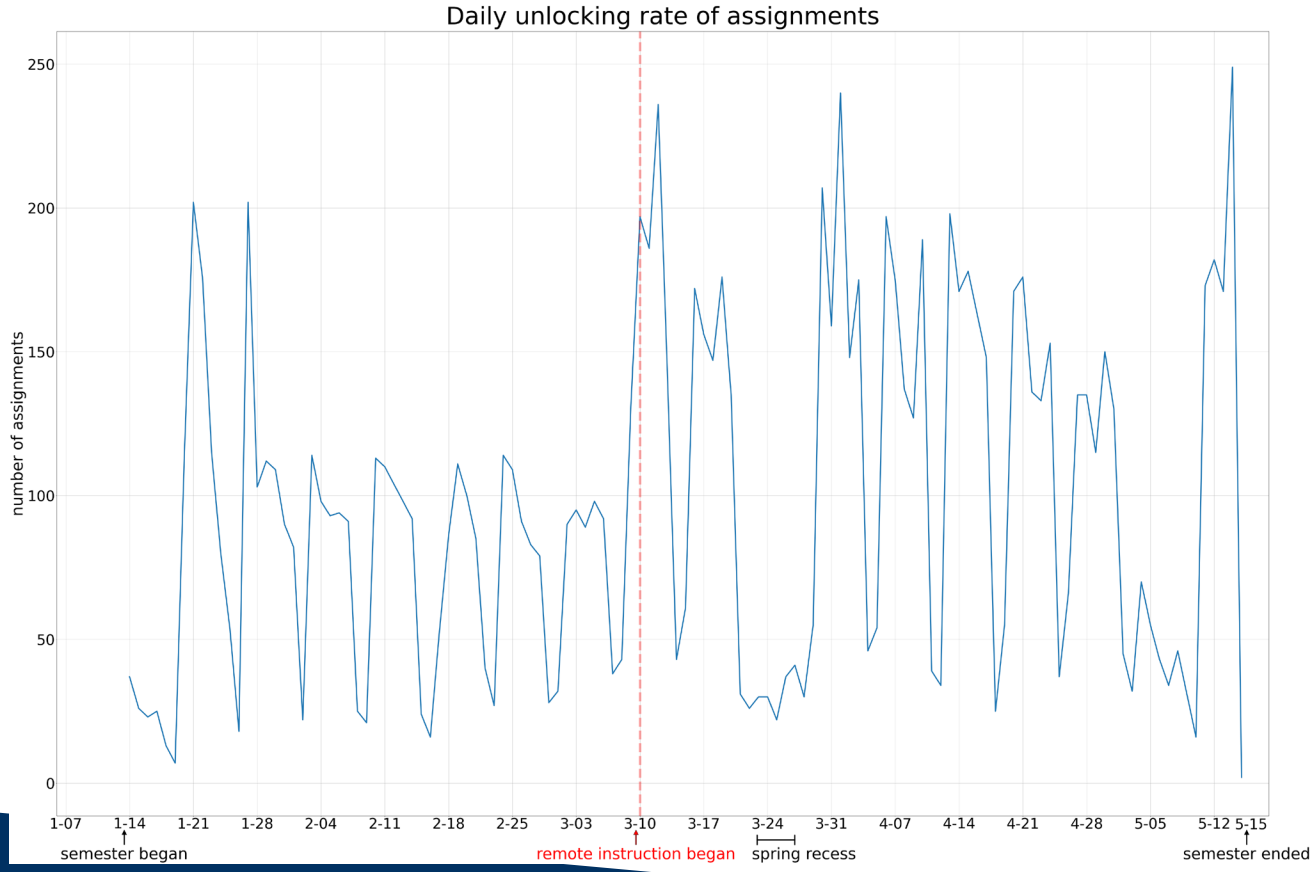
Instructor engagement

- Assignments released per day over the semester



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Instructor engagement

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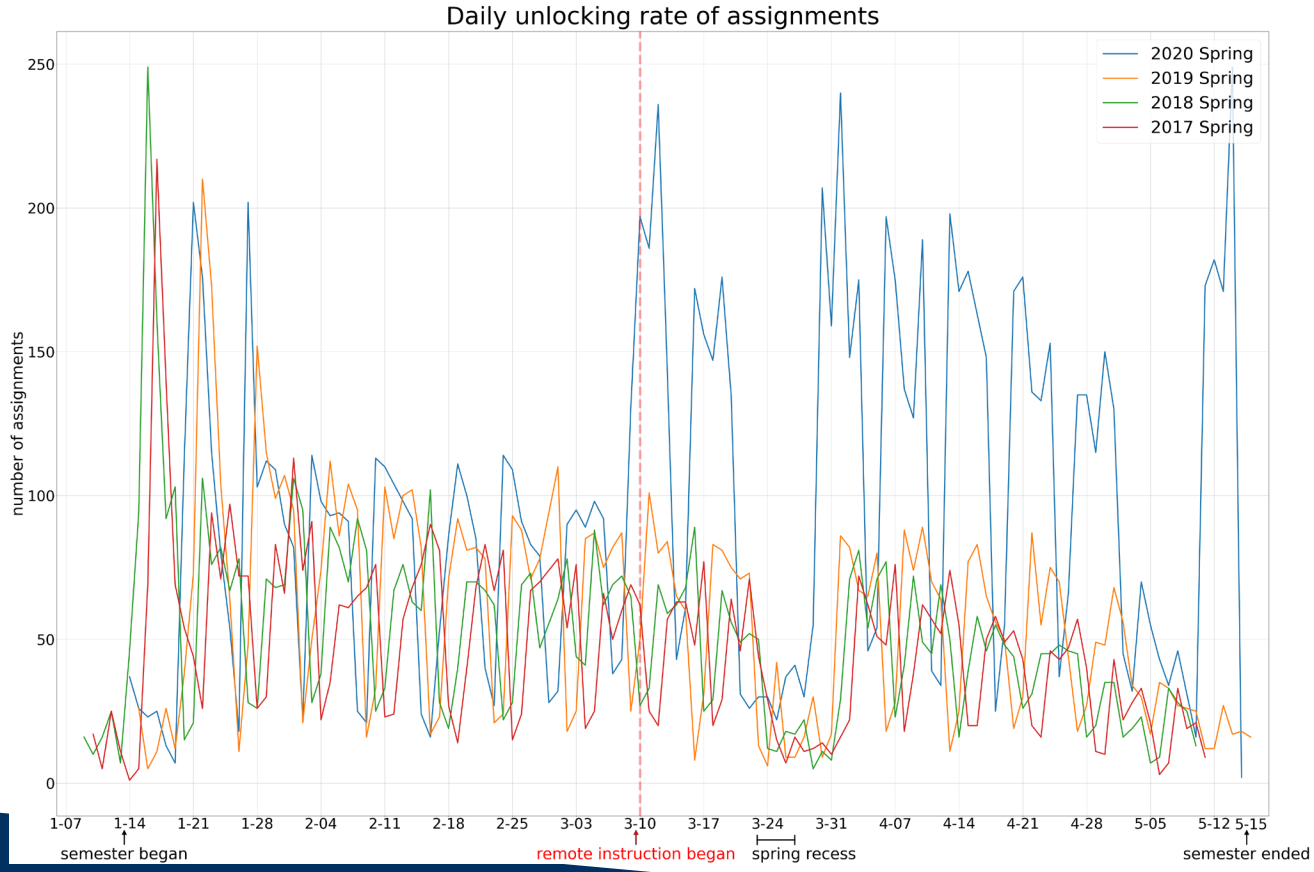

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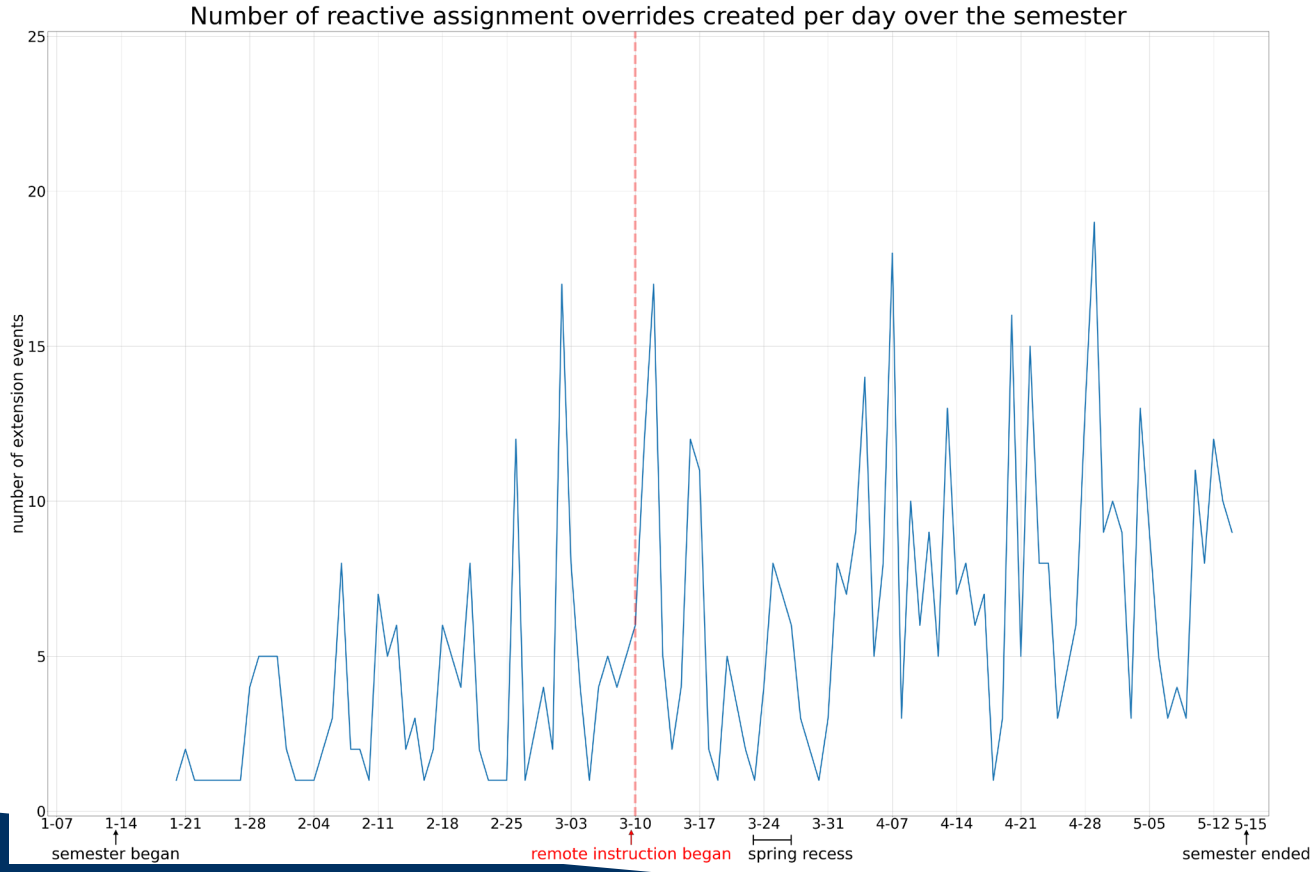
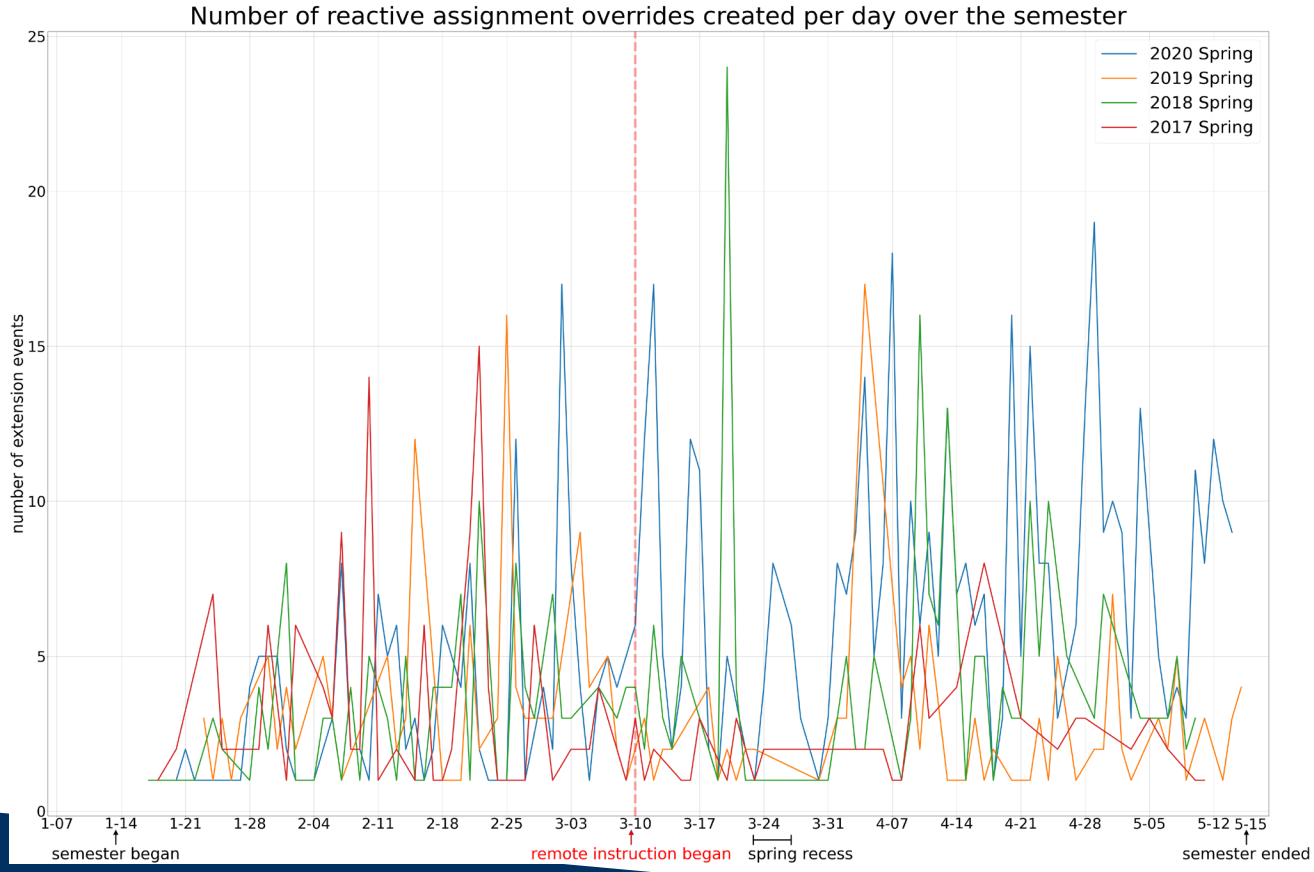
Instructor engagement

- Instructor changes to due dates after release (i.e., reactive extensions)



Instructor engagement

- Instructor changes to due dates after release (i.e., reactive extensions)



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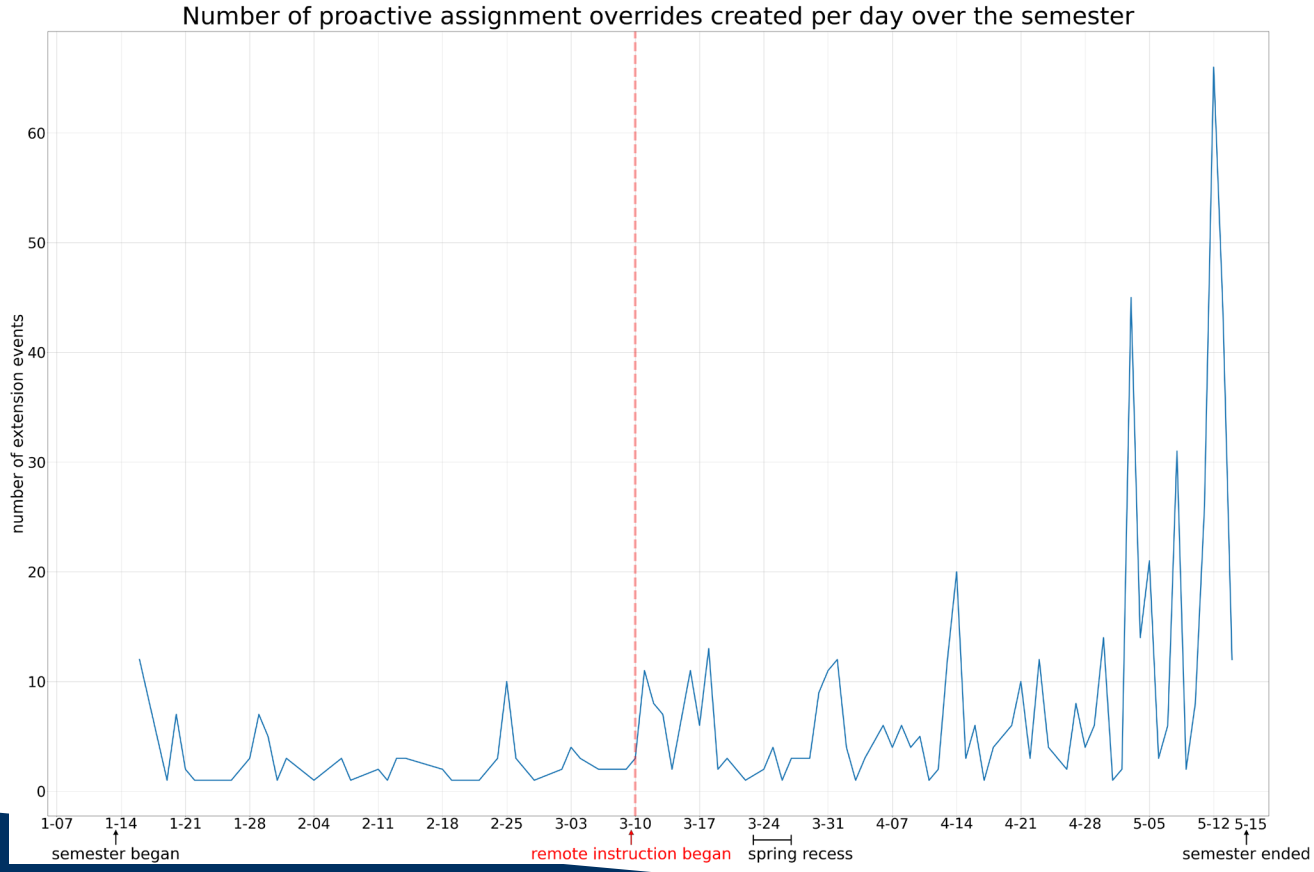
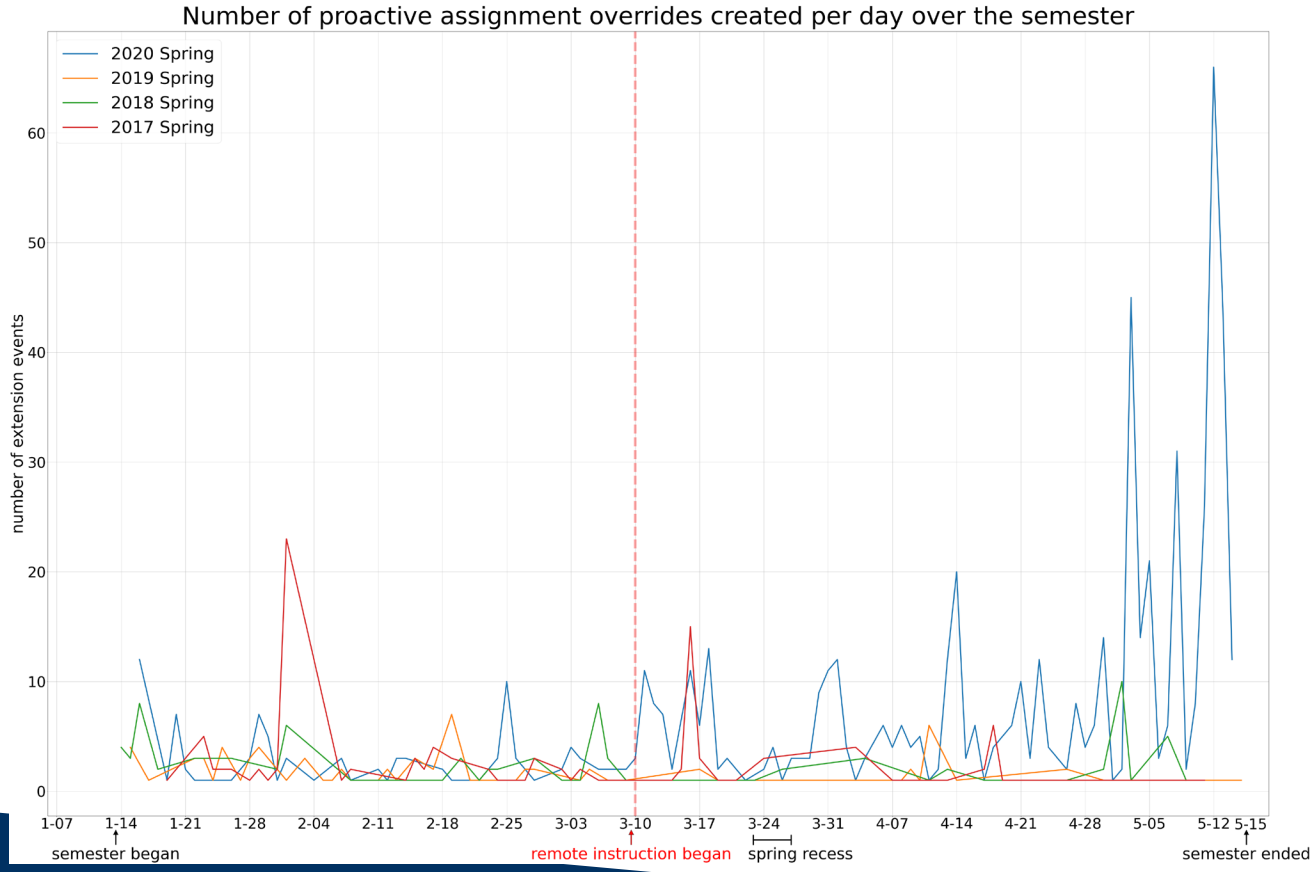
Instructor engagement

- Instructor changes to due dates before release (i.e., proactive extensions)



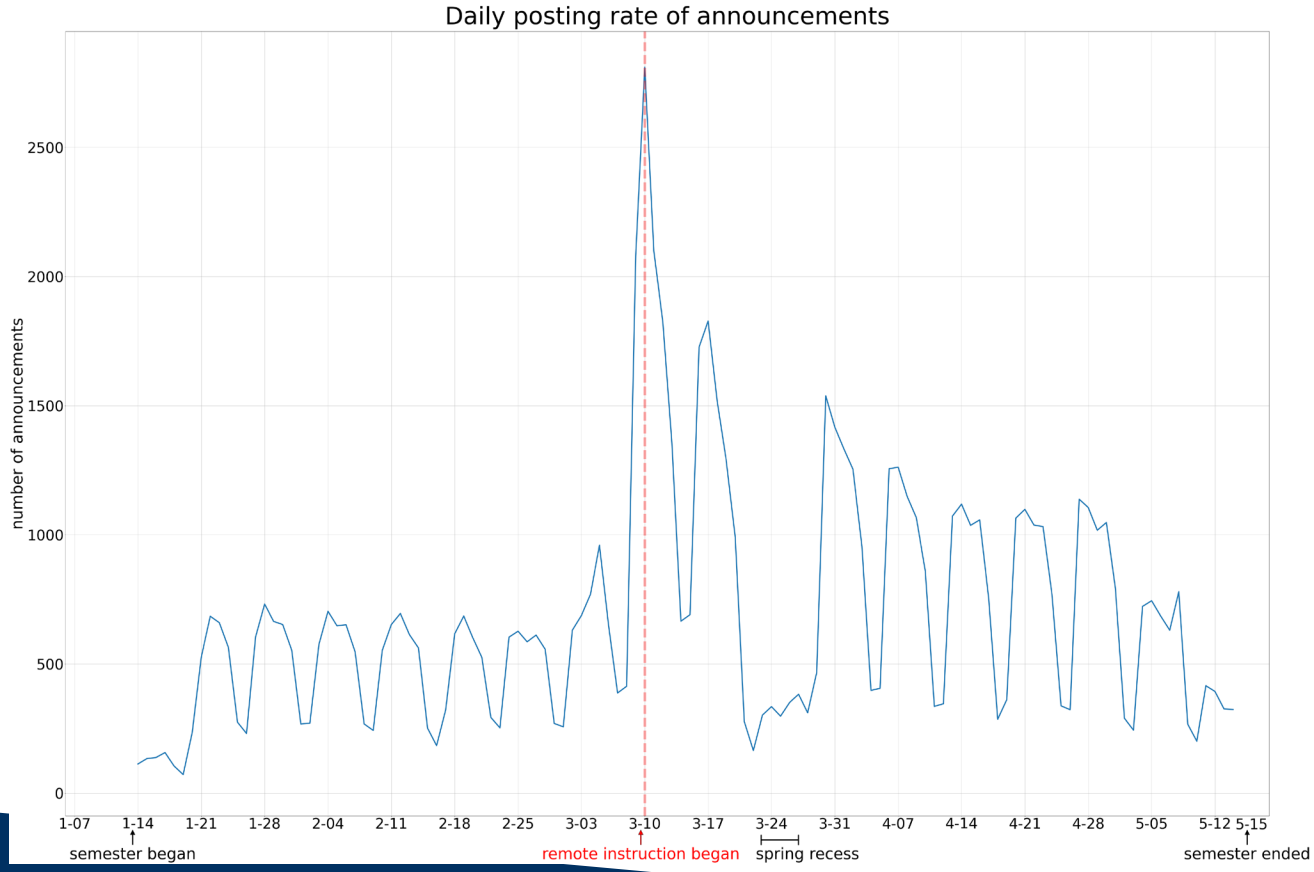
Instructor engagement

- Instructor changes to due dates before release (i.e., proactive extensions)



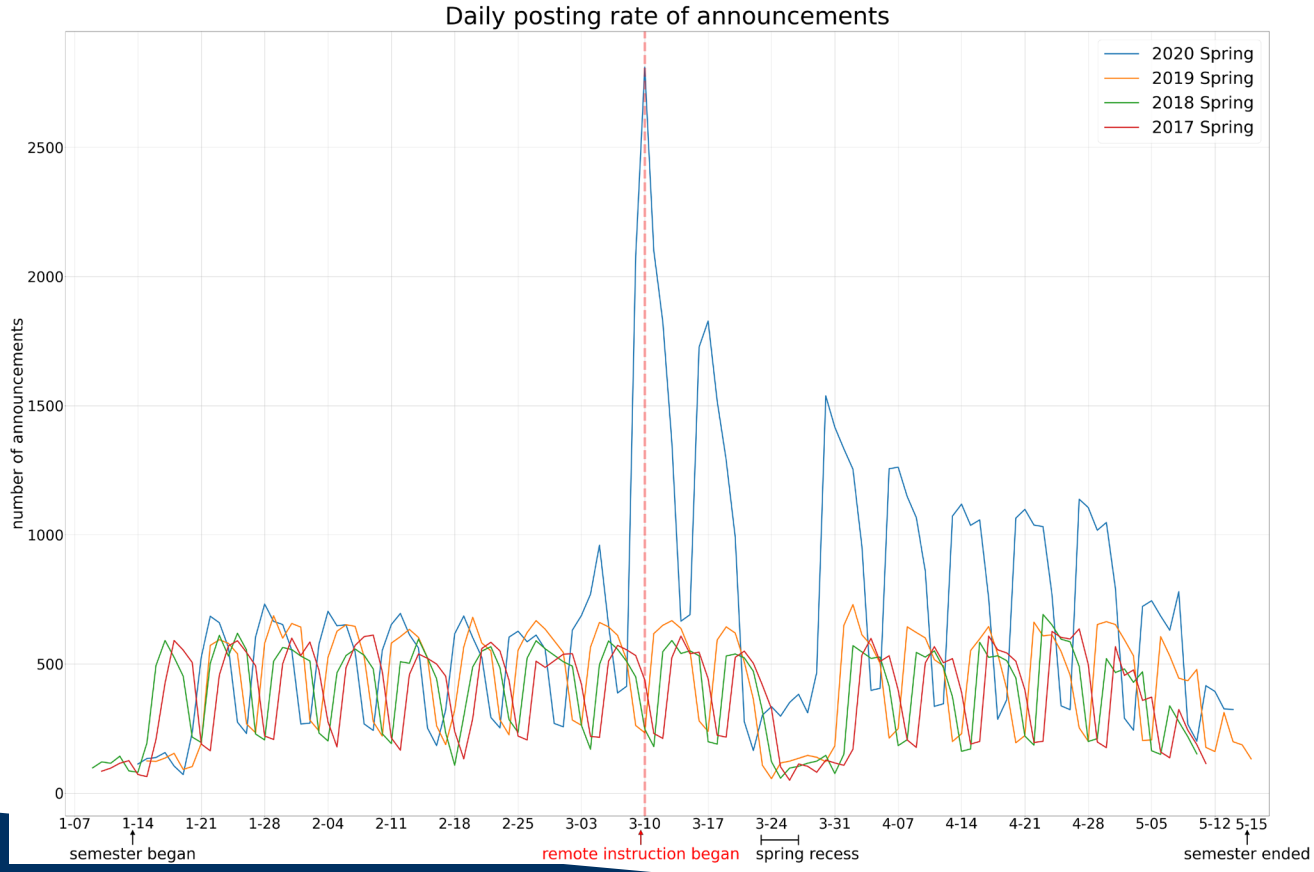
Instructor engagement

- Instructional staff announcements



Instructor engagement

- Instructional staff announcements



Instructor engagement

- Instructor time to grade assignments after submission

	Days taken
Semester	**Median**
Spring 2020 (before remote)	5
Spring 2020 (after remote)	4
Spring 2019	5
Spring 2018	6
Spring 2017	5

Instructor engagement

- Instructor comments on submissions

	before/after mid-March	proportion of assignments with at least one comment (%)	
2020 Spring	before	16.95	⇩ 19%
	after	13.67	
2019 Spring	before	18.48	⇩ 5%
	after	17.48	
2018 Spring	before	18.00	
	after	16.70	
2017 Spring	before	14.27	
	after	14.11	

Instructor engagement

- Length of instructor comments (in bytes)

semester	before/after remote	mean	std	median	max
Spring 2020	before	202.9330	385.7887	49	7,569
	after	**274.0545**	**519.8319**	100	**60,193**
Spring 2019	before	154.7915	312.2116	99	13,059
	after	183.3860	357.9608	**114**	13,299
Spring 2018	before	152.4350	344.2935	23	7,700
	after	154.8040	395.9743	23	22,450
Spring 2017	before	134.6125	351.1513	23	13,081
	after	164.0416	422.9255	23	13,999

median

⇧ 100%

⇧ 15%

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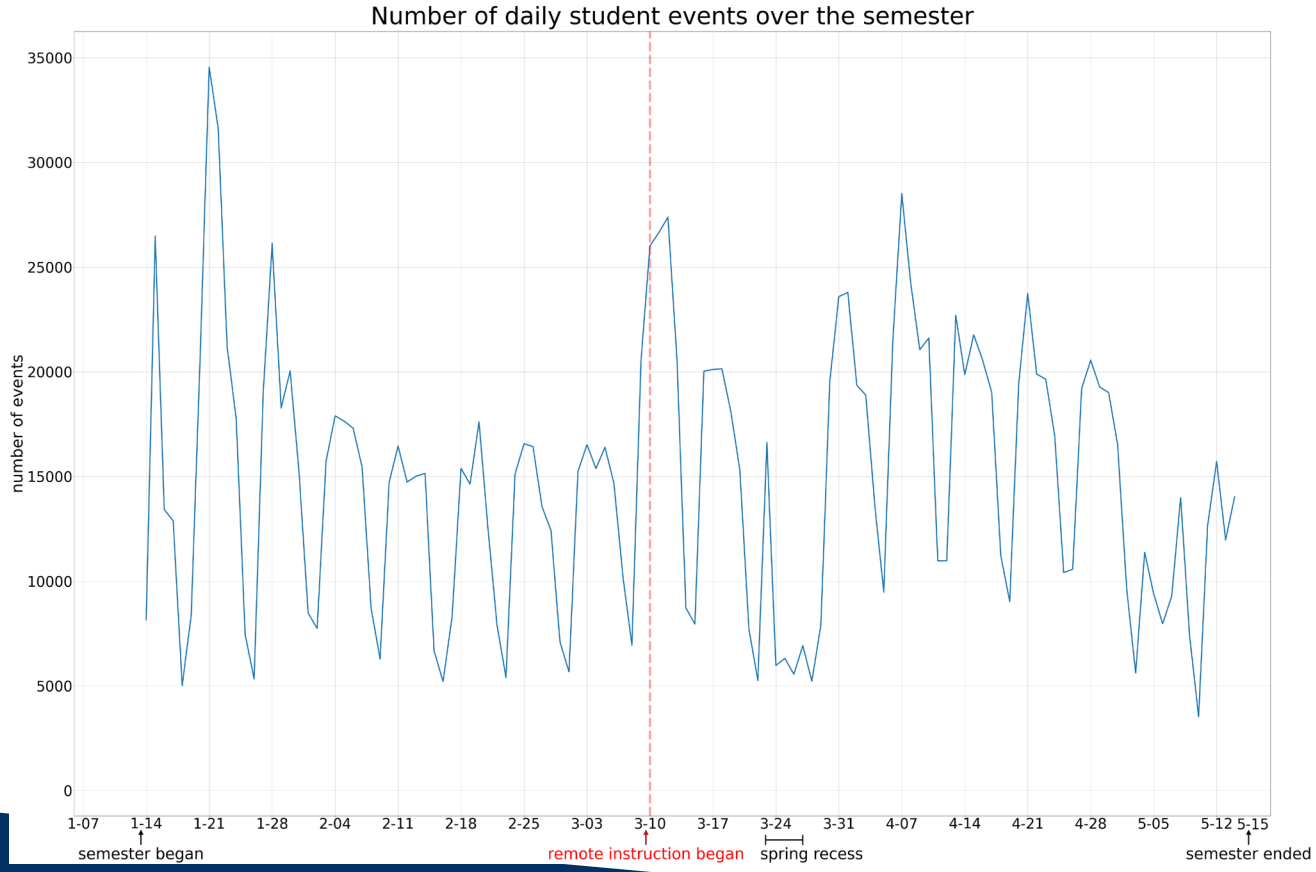
Student engagement analytics

(using LMS dataset)

- Total daily events
- Course drops
- Discussion activity
- Submissions per day
- Late submissions
- GPA on assignments

Student engagement

- Total number of daily student events



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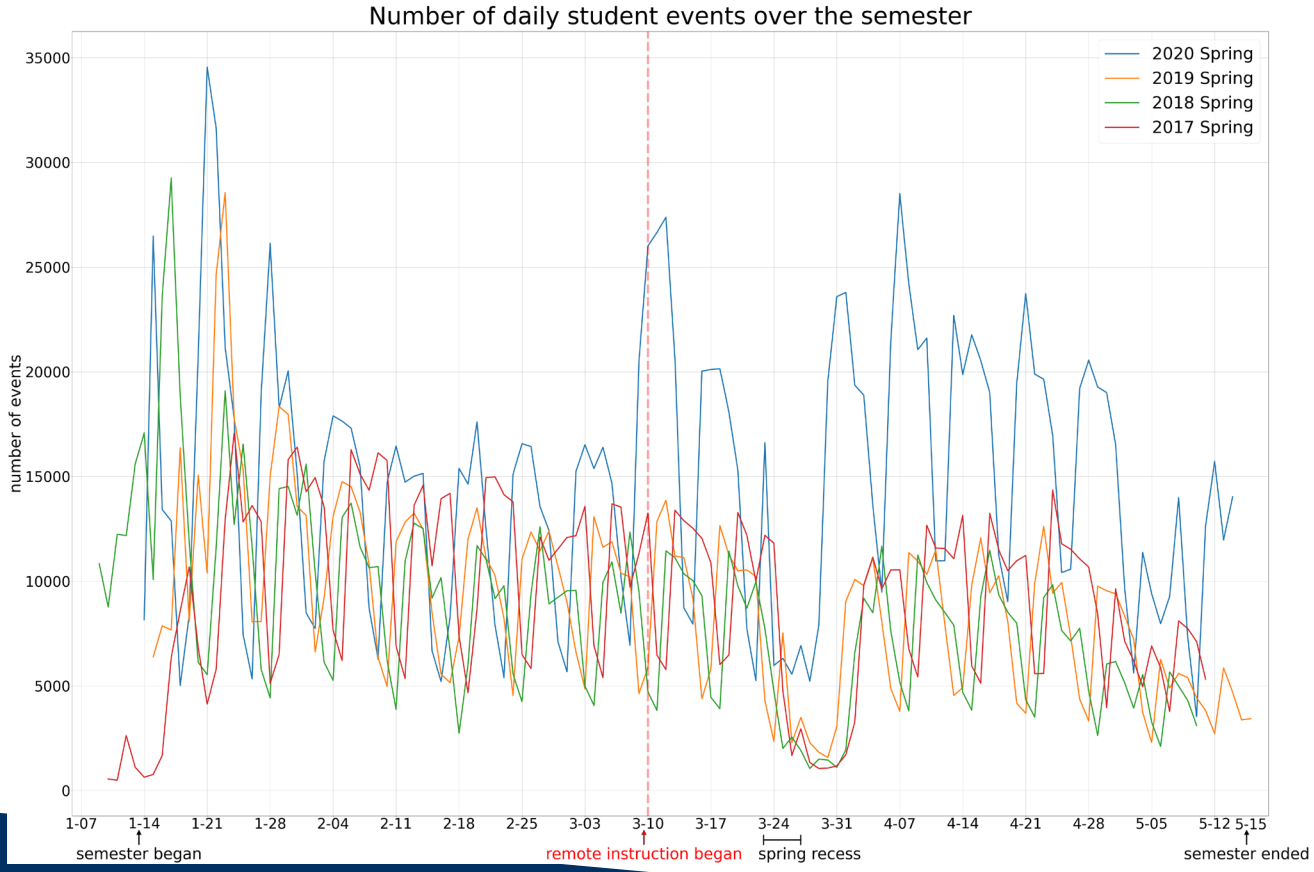
Student engagement

- Total number of daily student events



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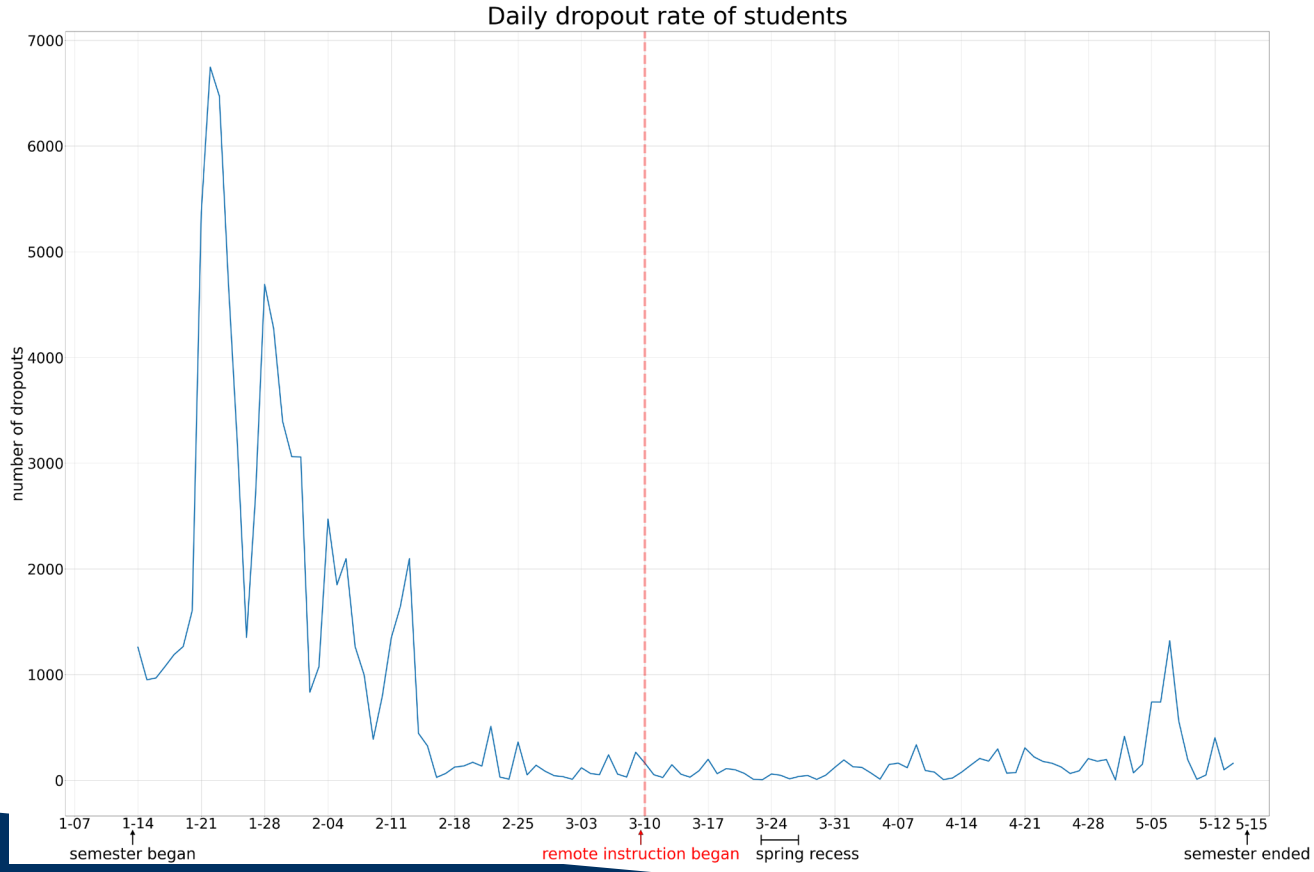
Student engagement

- Number of course drops per day



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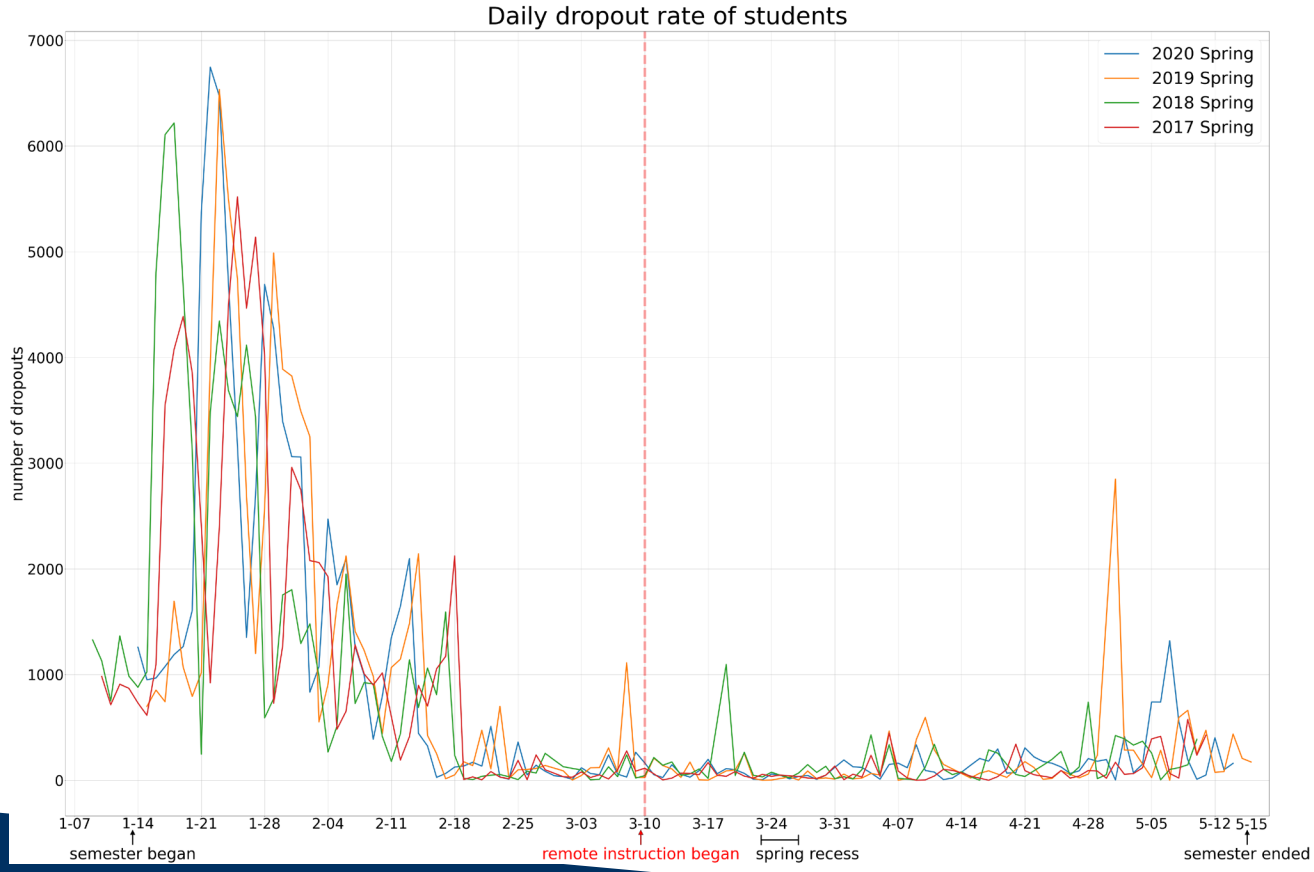
Student engagement

- Number of course drops per day



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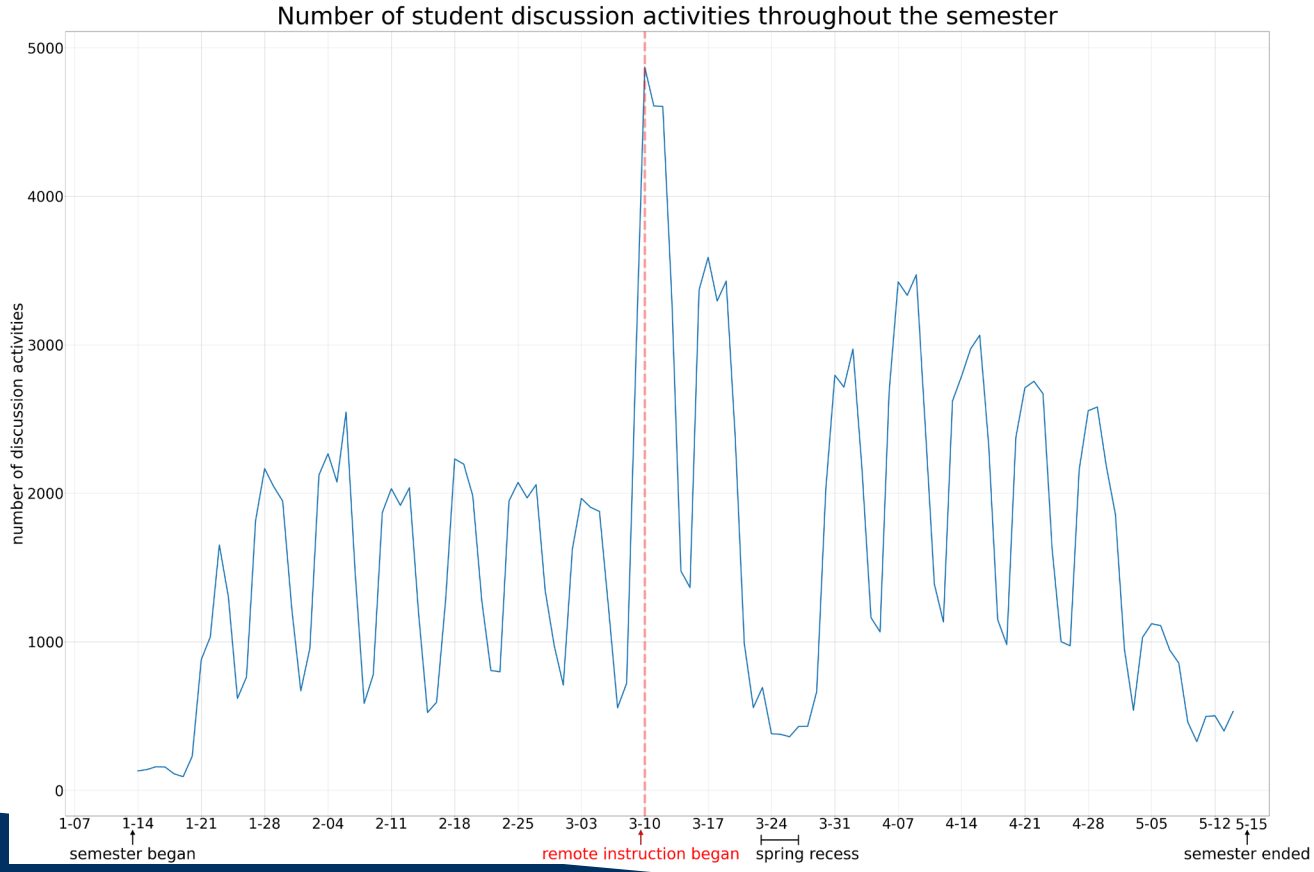
Student engagement

- Student discussion activity over the semester



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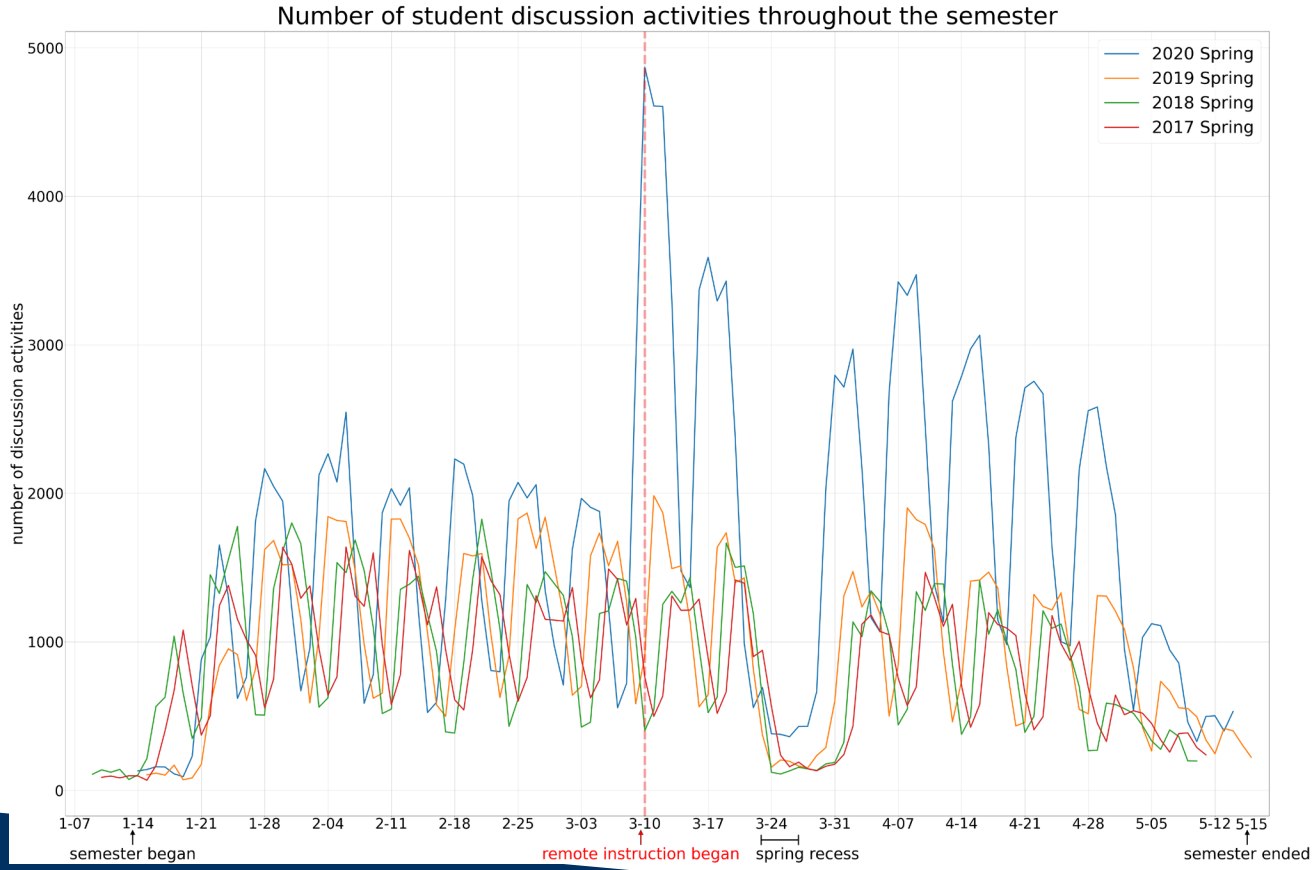
Student engagement

- Student discussion activity over the semester



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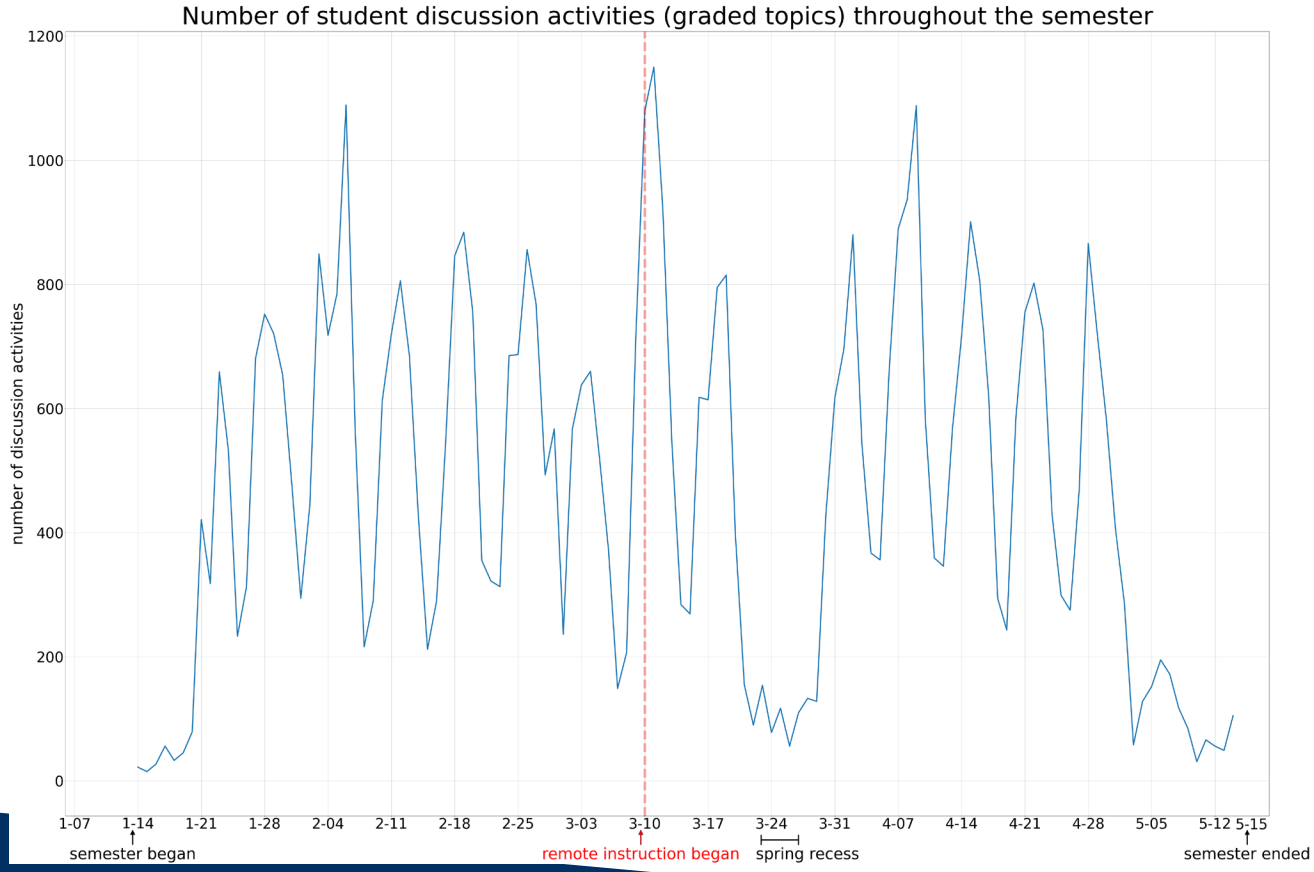
Student engagement

- Student discussion activity over the semester on graded topics only



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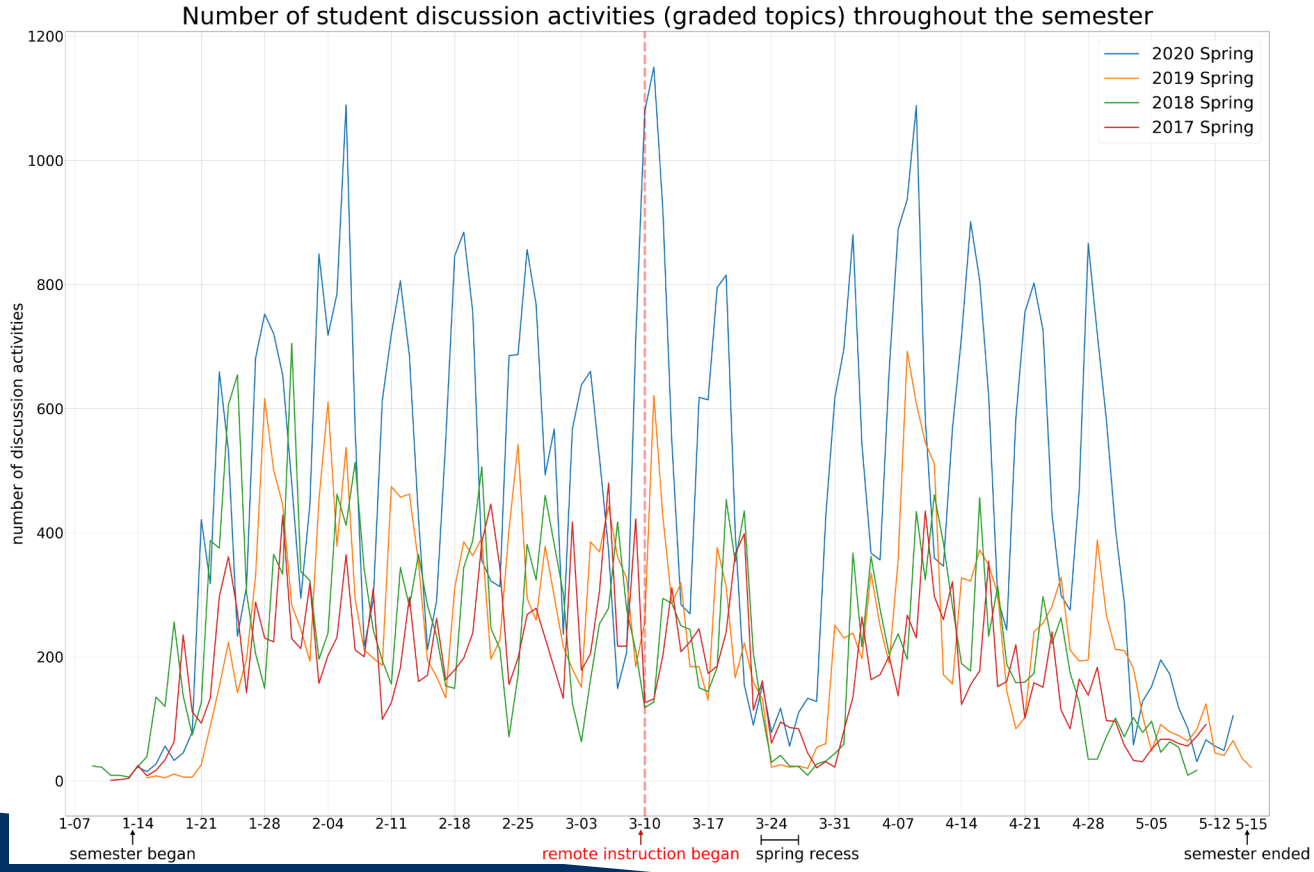
Student engagement

- Student discussion activity over the semester on graded topics only



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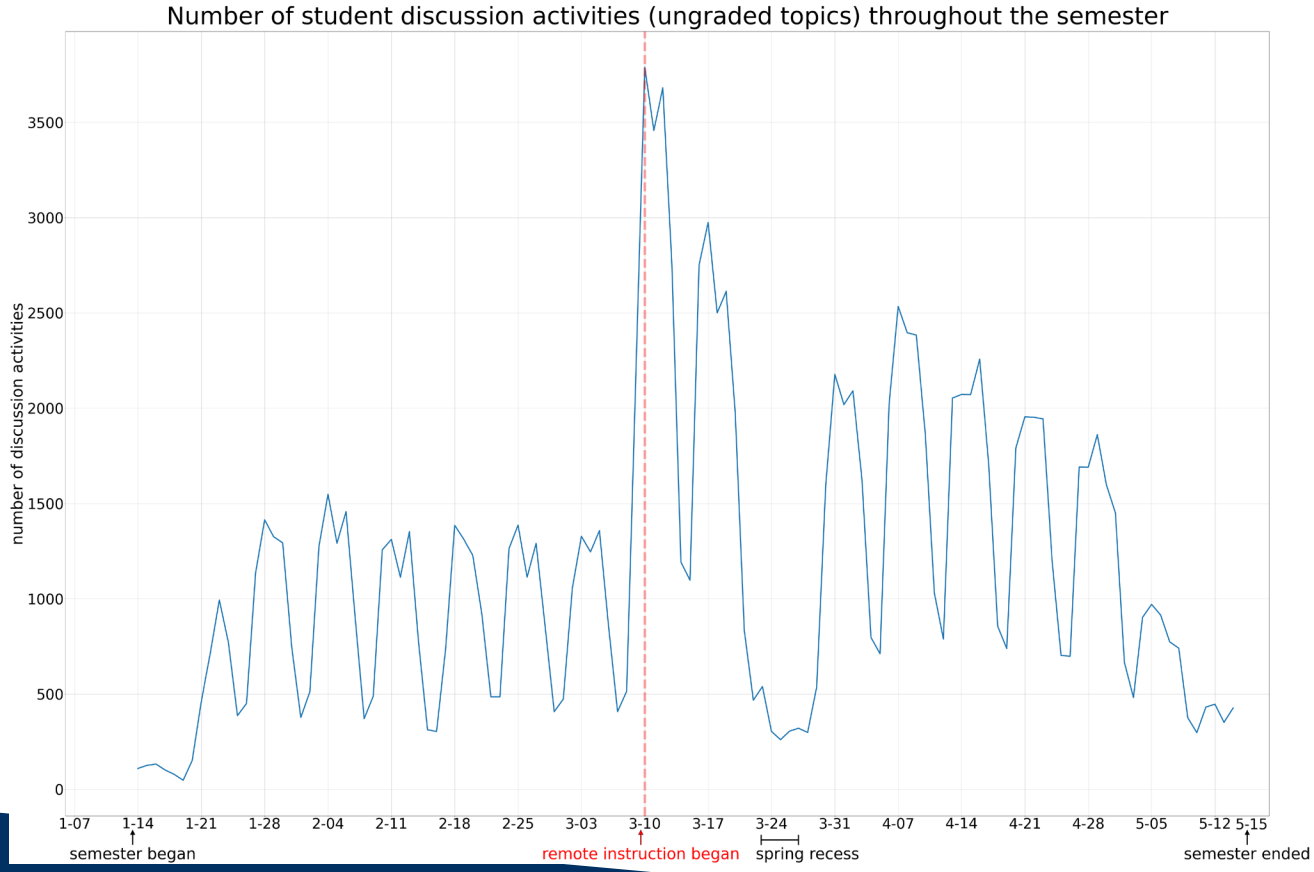
Student engagement

- Student discussion activity over the semester on ungraded topics only



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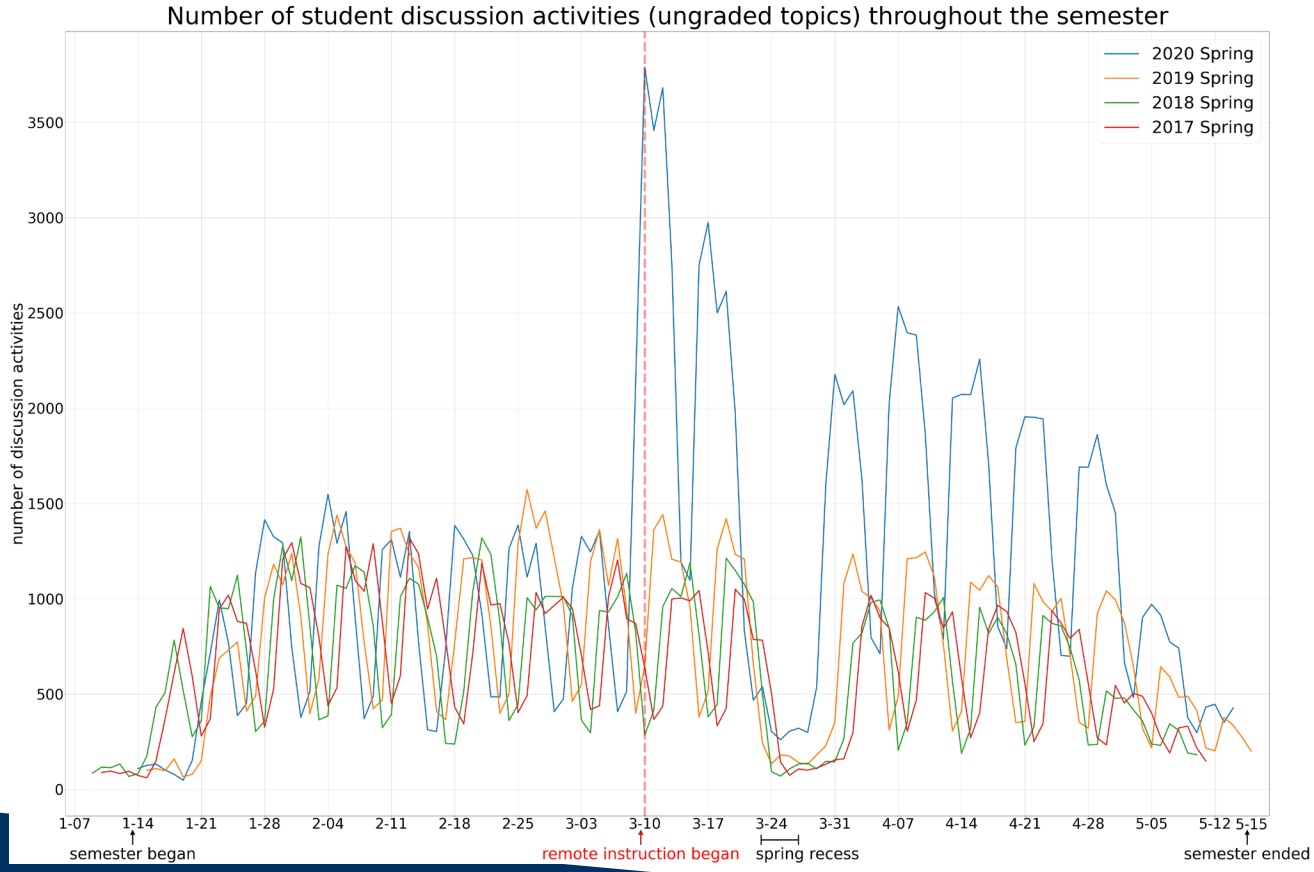
Student engagement

- Student discussion activity over the semester on ungraded topics only



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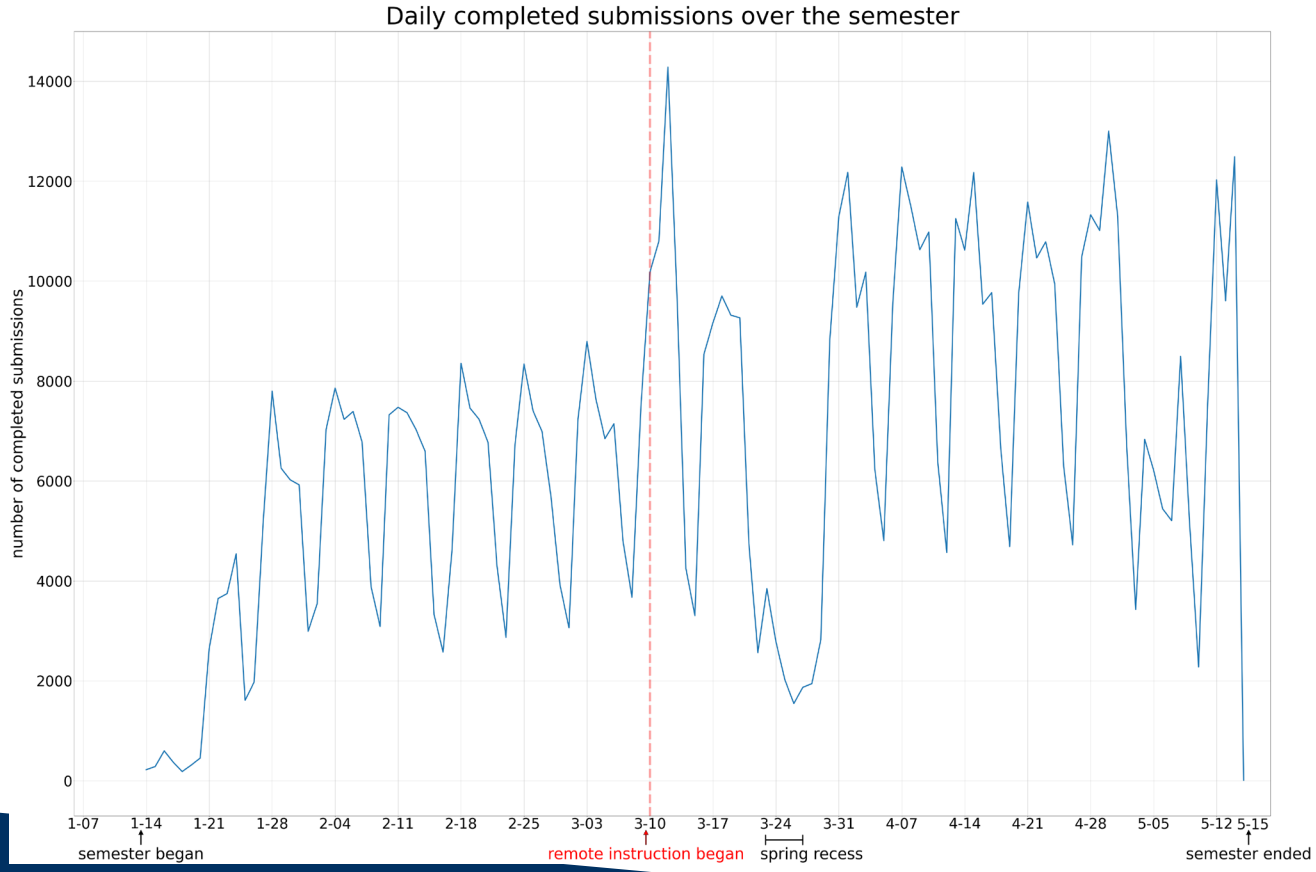
Student engagement

- Number of submissions per day



Student engagement

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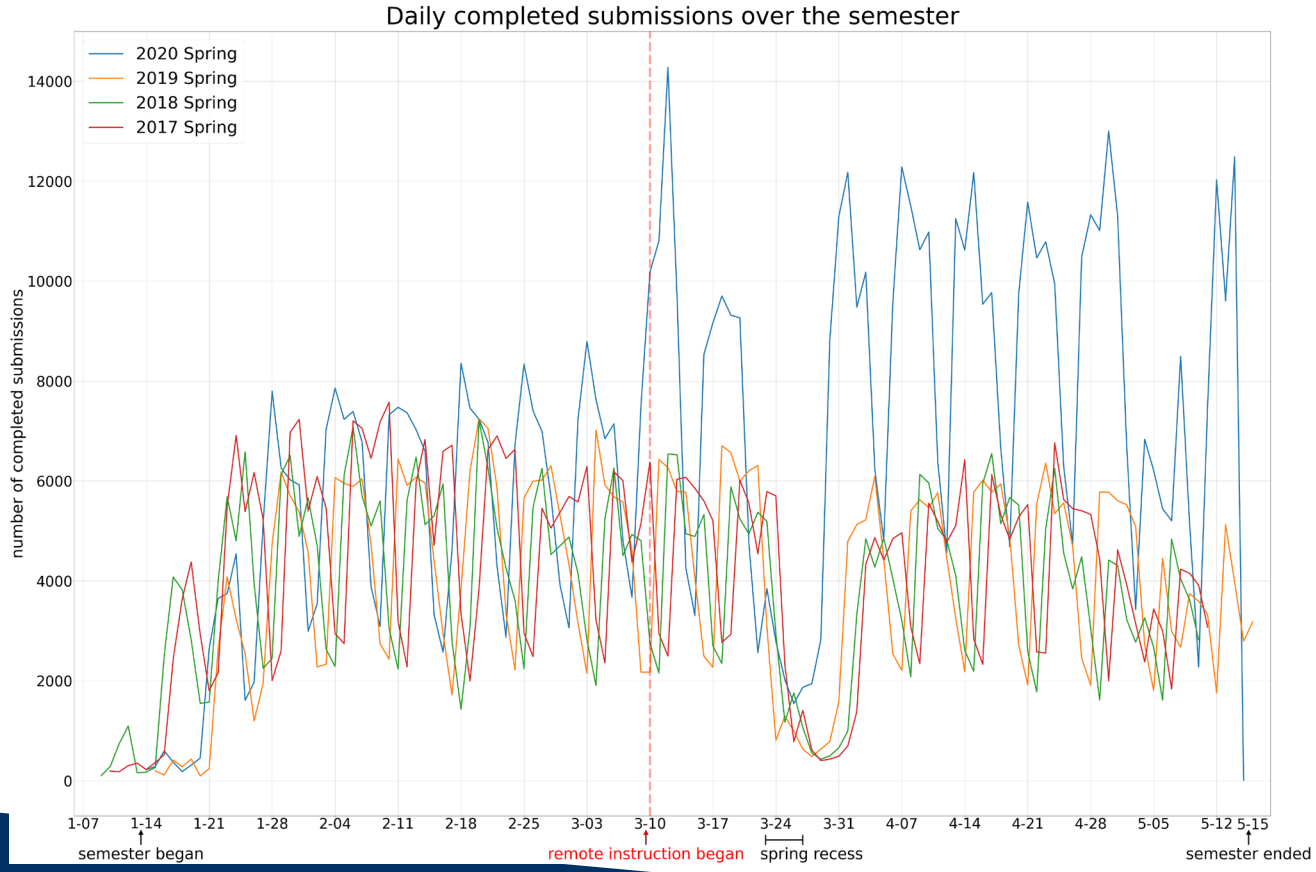

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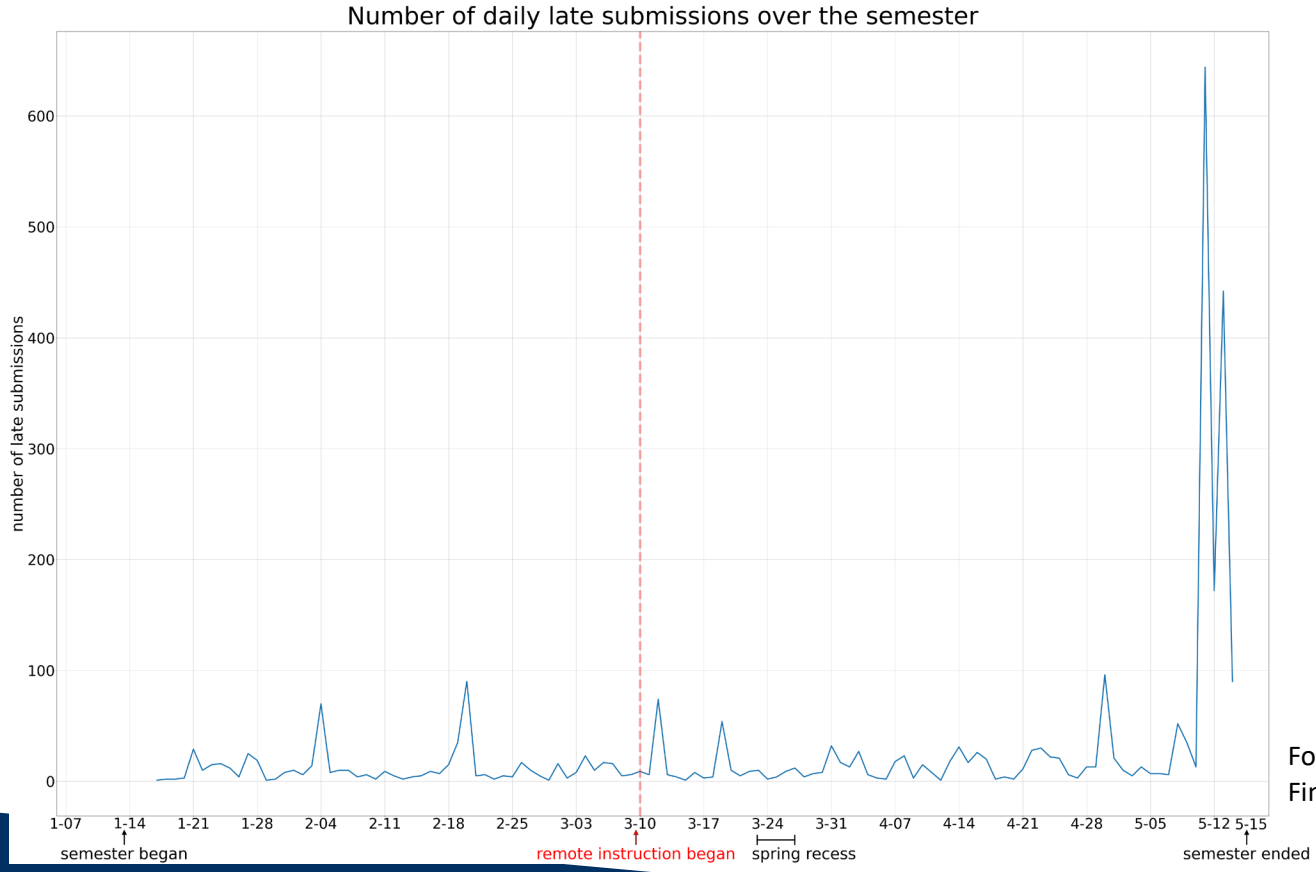
Student engagement

- Number of student late submissions



Formal classes end: 5-01
Final examinations: 5-11

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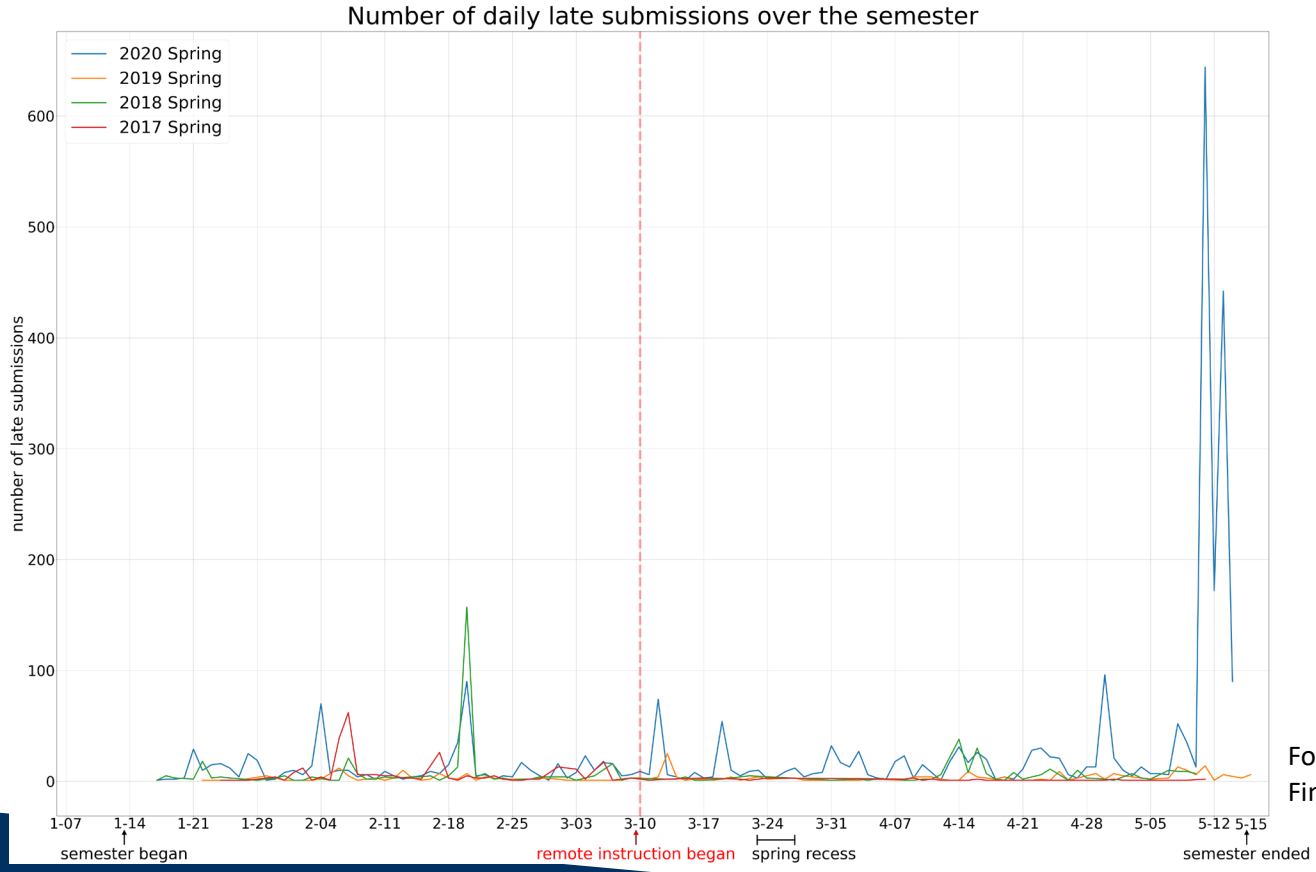
Student engagement

- Number of student late submissions



Formal classes end: 5-01
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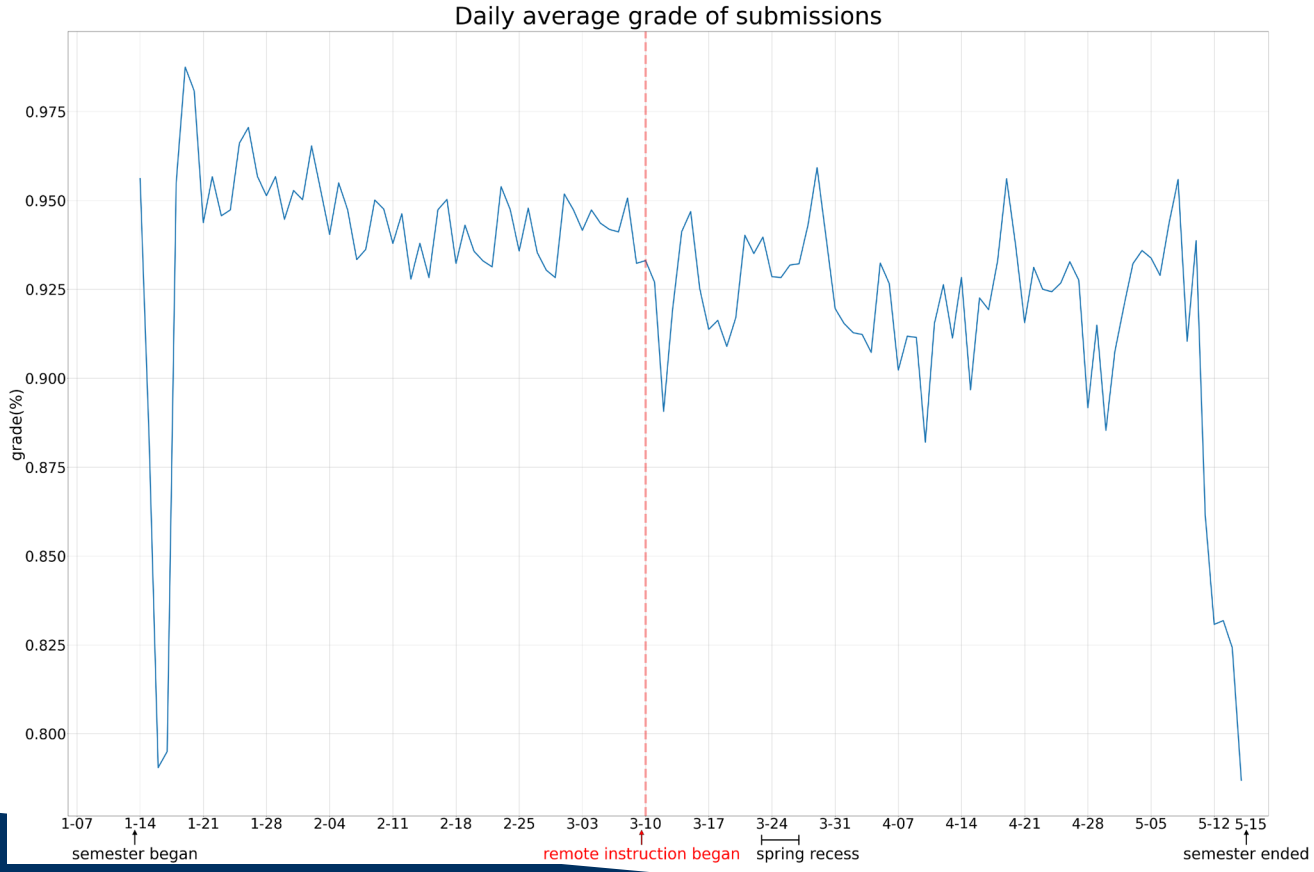
Student engagement

- Average grade on assignments turned in per day



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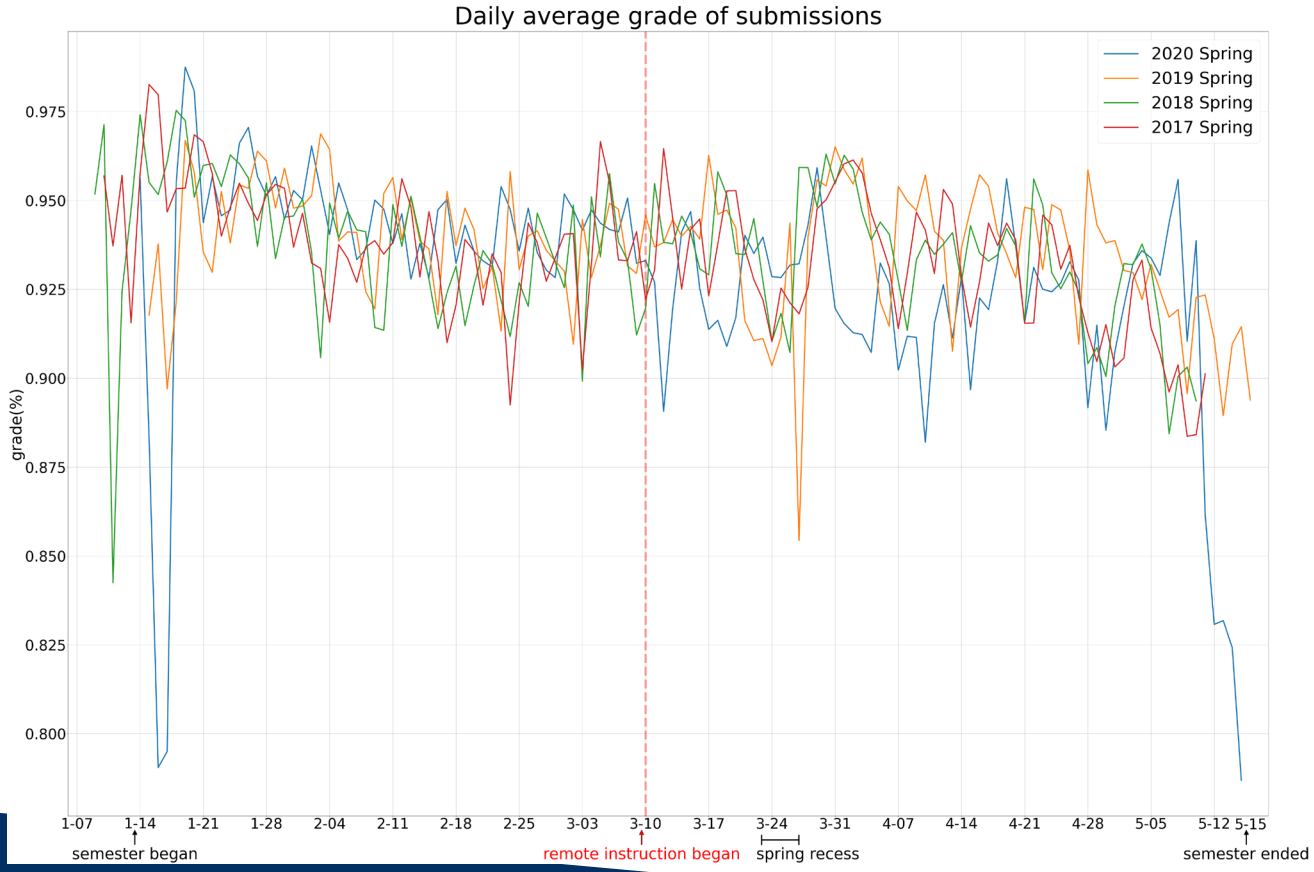
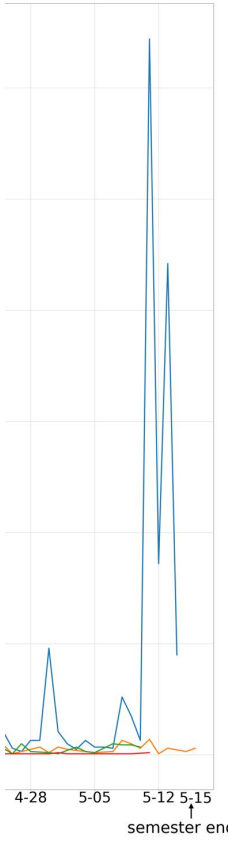
Student engagement

- Average grade on assignments turned in per day



Late submissions



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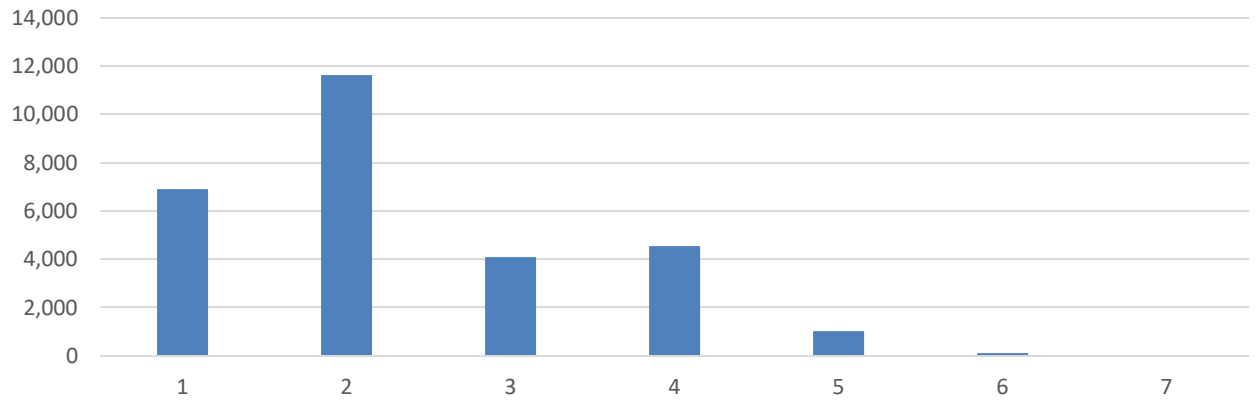
Student engagement by race

Was engagement of underrepresented students differently affected by emergency remote instruction?

Student engagement

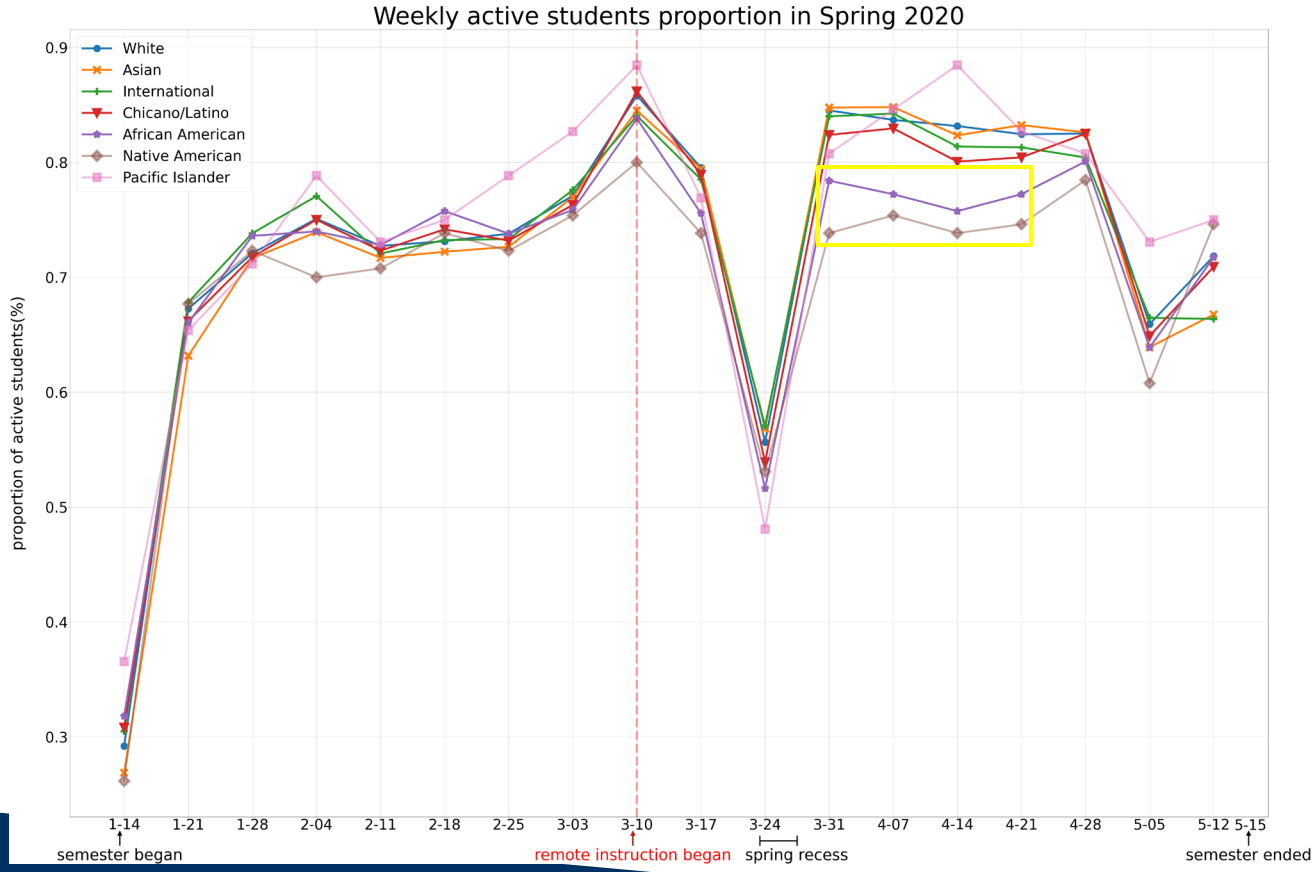
- Racial group breakdown (Spring 2020)

Race	White	Asian	International	Chicano/ Latino	African American	Native American	Pacific Islander
Students	6,921	11,617	4,077	4,566	1,019	130	52



Student engagement

- Percentage of active students per week



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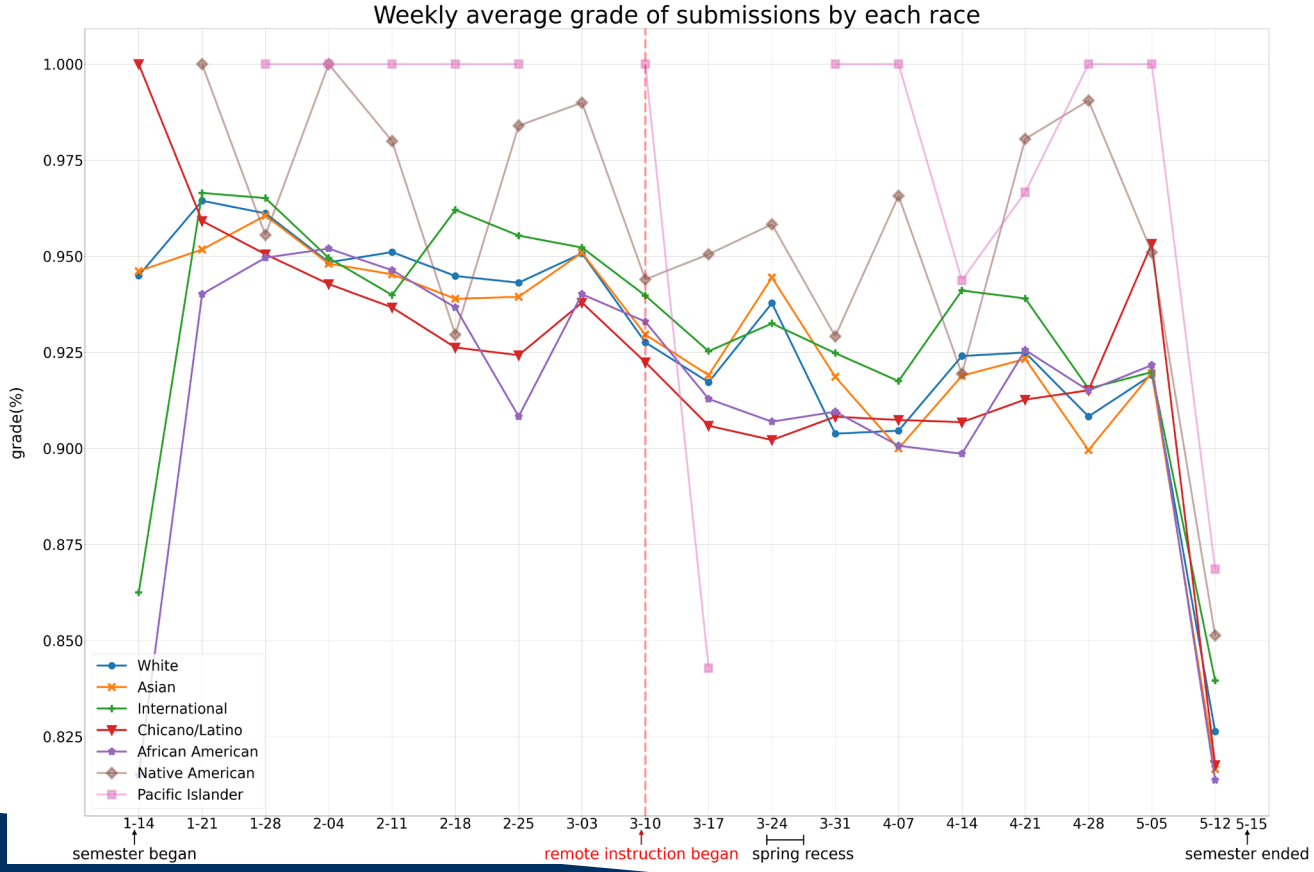
Student engagement

- Average grade on assignments turned in per day



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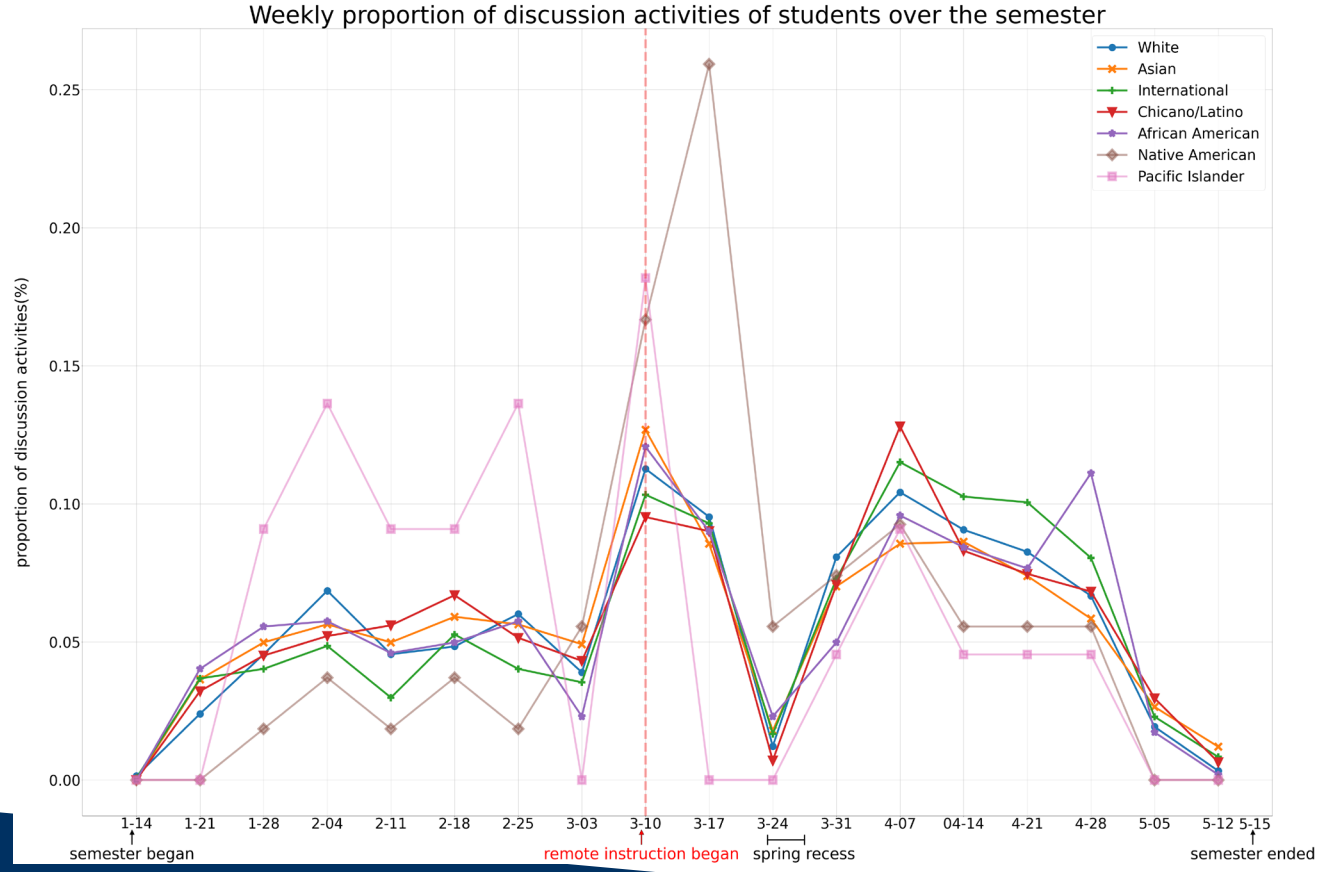
Student engagement

- Proportion of weekly student discussion activity



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Learning loss analysis

(using course enrollment dataset)

- Was preparation for future learning uniquely impacted by Spring 2020 instruction?
  - Method: Compare course GPAs in Fall 2020 of students who satisfied prerequisites during Spring 2020 vs other past semesters
  - Repeat analysis for Fall 2019 as a baseline

Learning loss analysis

GPA (and total enrollment count) of courses taken in Fall 2020 based on the semester in which students satisfied the prerequisite of the course

GPA in classes among students satisfying the prerequisite in

Classes Taken in	2020 Spring	2019 Fall	2019 Spring	Other semester	Not at Cal
2020 Fall	3.0981 (2,925)	3.2500 (2,004)	3.1913 (549)	3.2991 (1,695)	3.3468 (9,508)
Classes Taken in	**2019 Spring**	**2018 Fall**	**2018 Spring**	**Other semester**	**Not at Cal**
2019 Fall	3.0230 (3,086)	3.2105 (2,223)	3.1447 (629)	3.3287 (2,254)	3.1569 (8,941)

Analysis based on students who took at least one of the 519 Fall ‘20/’19 undergraduate courses that had a single prerequisite

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Learning loss analysis

Broken out by students who took the class for a letter grade vs Pass / No pass (P/NP)

Classes Taken in	2020 Spring		2019 Fall		2019 Spring		Other semester		Never	
	letter	P/NP	letter	P/NP	letter	P/NP	letter	P/NP	letter	P/NP
2020 Fall	3.5252 (2,245) (p=0.011)	1.6882 (680) (p=0.005)	3.5851 (1,627)	1.8037 (377)	3.5841 (428)	1.8017 (121)	3.6634 (1,361)	1.8144 (334)	3.6395 (7,986)	1.8108 (1,522)
Classes Taken in	**2019 Spring**		**2018 Fall**		**2018 Spring**		**Other semester**		**Never**	
	letter	P/NP	letter	P/NP	letter	P/NP	letter	P/NP	letter	P/NP
2019 Fall	3.1490 (2,852) (p<0.001)	1.4872 (234) (p=0.975)	3.2859 (2,130)	1.4839 (93)	3.2730 (586)	1.3953 (43)	3.4725 (2,072)	1.6923 (182)	3.3002 (8,197)	1.5780 (744)

P-values are t-tests between the grades of students satisfying the prerequisite in Spring (2020 or 2019) as compared to the previous Fall for the corresponding grade type

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Conclusions - Loss

- There was a 6.4% higher percentage of *No Pass* grades in Fall 2020 courses among students who satisfied the prerequisite in the emergency remote instruction semester
- Late assignment submissions increased substantially near the end of the emergency remote instruction semester
- There was an engagement drop of 6-10% among African American and Native American students compared to other groups during the three weeks following spring recess

Conclusions - Resilience

- Instructors increased grading speed and length of LMS-delivered assignment feedback during emergency remote instruction
- Students stayed engaged (and online) throughout most of Spring ’20 with no significant change in course drops compared to past semesters
- Students connected over discussion forums, doubling posting activity during emergency remote instruction as compared to past spring semesters
- An analysis of grades on postrequisite courses taken in the semester after emergency remote did not suggest learning loss among students who took the postrequisite course for a letter grade

Limitations

- Not all events were included in our LMS dataset
  - Click-level interactions with course pages were not included
  - Course and submission content was not included
- Non-uniform use of LMS features among instructors
  - Example: College of Engineering instructors widely use Piazza instead of bCourses/Canvas for discussion posts
- Learning loss analysis was based on course prerequisite relationships which are not common in all schools and departments
- Fall 2020, used to measure learning loss, was also a remote semester

Credits

- Research, Teaching, and Learning (provided LMS data)
  - Sandeep Markondiah Jayaprakash
- Enterprise Data and Analytics (provided enrollment data)
  - Mithra Bandi, Radha Karichedu, Aswan Movva
- Equity and Inclusion (demographics)
  - Andrew Eppig
- Office of the Registrar (enrollment analysis approval)
  - Walter Wong
- Graduate Student (jupyter notebook assistance)
  - Weijie Jiang
- Special Thanks
  - Jenn Stringer, Shawna Dark, Cathy Koshland, Paul Alivisatos

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Replicability

- Open-source code for the LMS and enrollment-based studies is available on GitHub:

  https://github.com/CAHLR/Remote-Instruction-Analysis

Resilience or Loss? Learning Under Emergency Remote Instruction at Cal

A Learning Analytics Perspective

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